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Merickel, Michael Reilly.

Monterey, California. Naval Postgraduate School

A NOISE EXPOSURE FORECAST EVALUATION OF THE MONTEREY PENINSULA AIRPORT

Michael Reilly Merickel

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

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OF THE
MONTEREY PENINSULA AIRPORT

by

Michael Reilly Merickel

Thesis Advisor: Louis V. Schmidt

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A Noise Exposure Forecast Evaluation of the Monterey Peninsula Airport

by

Michael Reilly Merickel
Lieutenant, United States Navy
B.S., United States Naval Academy, 1967

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ABSTRACT

A computer program, developed by Bolt, Beranek, and Newman, Inc., for the Office of Noise Abatement, Federal Aviation Administration, under Contract No. FA68WA-1900, was adapted to the NPS W. R. Church computer facility and was subsequently utilized to obtain contours of noise exposure for the Monterey Peninsula airport. Two scenarios are presented for the present volume of operations and the resulting NEF contours are shown in Appendix B. The same two plots, with a doubled volume of operations, are depicted in Appendix C for a relative comparison. These noise exposure forecasts can be used for noise evaluation and compatible land-use planning in the vicinity of an airport.

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I. INTRODUCTION

When Assembly Bill 645 (1969), for the state of California became law on December 1, 1971, it became mandatory for airports operating under a permit from theCalifornia Department of Aeronautics to operate according to specified noise standards. The acoustic standard adopted by the state of California is the Community Noise Equivalent Level (CNEL), which takes into account the following factors: the magnitude of noise from each flight, the duration, the number of flights, and how the total number is distributed among three time periods (day, evening and night).

Each airport generates a noise environment, because of the aircraft operations, which can be depicted by drawing noise contours - lines of equal CNEL, like the lines of equal elevation on a topographical map. The standard adopted by California, sets a limit on the CNEL scale above which it is considered unsuitable for residential use. This particular CNEL contour is termed the "noise impact boundary". The California law states in effect that an airport must be operated in a manner so that the noise impact boundary does not spread so far as to encompass any residential areas. [Ref. 1]

The California Legislature realized that many existing airports would be in violation of the standard when it became law. It was

therefore determined that the allowable noise impact boundary for existing airports would be the CNEL = 70db contour until 1985, when the numerical limit would be CNEL = 65db. According to the law it is the responsibility of the county to determine if any airports in its jurisdiction have a noise problem. If the county believes an airport has a noise problem, it is then the responsibility of the airport to determine the boundaries of the noise impact area. If it is found that there are residential areas within the noise impact area, the airport must then take corrective action. The airport must also install noise monitoring equipment to insure the residential areas are protected. After the monitoring equipment is installed, the airport is liable for a $1000 fine for each single violation of the noise standards.

The following excerpt is taken from the preamble of the California Noise Standards:

> The regulations are designed to cause the airport proprietor, aircraft operator, local governments, pilots, and the department to work cooperatively to diminish noise. The regulations accomplish these ends by controlling and reducing the noise in communities in the vicinity of airports. [Ref. 2]

It is true that if the regulations were followed it would eliminate a major portion of the noise problems associated with airports. However, the implicit cooperation required between various agencies, serves more to confuse the issue rather than bring it out into the open.

At this time, California is the only state which uses the CNEL procedures. Military bases in the United States use the Composite Noise Rating (CNR) and civilian airports use the Noise Exposure Forecast (NEF) for determining compatible land usage. Appendix D, which was obtained from Ref. 1, shows the comparisons between the three different methods and their defined associated land usages. Because the NEF method is the most prevalent, this procedure will be used for the evaluation. By using Appendix D, the results of the NEF analysis can readily be converted to CNR or CNEL.

In addition to the California Noise Standards law, impending legislation by the Environmental Protection Agency (EPA) makes it clear that the problem of noise pollution has to be addressed. The EPA is expected to announce in October, 1973, standards for all airports in the country. One requirement will be a noise certification study for each airport in the country [Ref. 11]. This thesis, in conjunction with the computer program, should be an extremely helpful tool for certifying the Monterey airport for noise levels, whether the final EPA standard uses CNR, CNEL, or NEF procedures.

A. APPLICABILITY TO MONTEREY

In April 1973, the Monterey Peninsula Airport District Board entertained a motion that a noise study be conducted to determine whether or not the Monterey airport had a noise problem. After a presentation and proposal was made to the board by an independent

consulting firm, it was determined by the airport district directors that because of possible legal repercussions, it was not in the best interests of the district to instigate such a study, even though section 5004 of the California Noise Standards states that nothing in the regulations shall be construed as setting noise levels applicable in litigation. There was also a legal concern whether or not an airport could initiate a noise study rather than the county, as stipulated by state law, without incurring a legal liability.

One of the major issues concerning any airport which services commercial jet aircraft is the problem of excessive noise affecting the surrounding community. More than any other factor the noise problem is likely to become the "rallying cry" for any group or community that wishes to oppose airport policy. In an age where air travel is increasing faster than any other mode of public transportation, it is imperative that airport authorities be responsive to community perceptions.

The Monterey Peninsula is regarded as an area of scenic beauty, pleasant climate, little congestion and a convenient geographical location. Many local groups wish to preserve this climate and they see any attempt to change the status quo as a threat to the environment.

Because of the apparent conflict between the growing demand for air travel and the desire to maintain a pollution free environment, it is necessary for airport management to address itself to the present, or

potential problems, of environmental conflict. The Monterey Peninsula Airport District Board of Directors has advocated a central noise complaint data collection system. Although this was a genuine attempt to establish whether or not the community was concerned about the present noise level, it has proved to be an ineffective measure because the community was not aware of this attempt and there was no coordination between the FAA and the airport in collecting and recording complaints.

Since the California Noise Standards have become law, it seems to be beneficial to the Airport District to know whether or not they are operating within the law. Even though it is the responsibility of the county to determine which airports have a problem, it is not felt that the airport should wait until directed to determine if it has, or could foreseeably have, an unlawful noise situation.

This report is meant to be an initial indication to describe the noise environment in the Monterey Airport vicinity. The analysis considered present operations, possible alternatives and projected future flight activity in the Monterey area.

Because of the geographical location of the Monterey airport and the surrounding topographical features, the principal runway for takeoffs is runway 28 and for landings, runway 10. When referring to a runway by number, a takeoff on runway 28 means a takeoff on an approximate magnetic heading of 280 degrees, while the reciprocal

heading, when referring to runway 10 means a landing on the same runway but on an approximate magnetic heading of 100 degrees. It was recognized that there are exceptions to this practice because of meteorological conditions and other considerations. However, since a western approach and departure is usually the standard for all aircraft other than small general aviation airplanes this was the assumed traffic flow for the analysis.

The above procedure of having all aircraft departing to, or approaching from the West, describes the most severe noise impact on the surrounding community. Whenever the traffic flow is varied from this procedure, the resulting noise impact on the residential areas is decreased. The Federal Aviation Administration (FAA) employees who control the flow of aircraft are conscious of and make an earnest effort to minimize the noise when possible, through the use of varying the approach procedures. When the weather and wind conditions are favorable, the air carriers are encouraged to make their approaches from the West and enter downwind for a landing on runway 28, but because of the hills east of runway 10, the prevailing westerly winds, and the one and a half degree positive gradient on runway 10, takeoffs are usually made to the West.

II. NEF DEVELOPMENT

A. CONCEPTS AND APPLICATIONS

The Noise Exposure Forecast (NEF) value at a ground position provides an estimate of the time integrated noise exposure resulting from aircraft operations. The NEF values are calculated from: a) measures of the aircraft flyover noise described in terms of the effective perceived noise level (EPNL), and b) the average number of flyovers per day (0700 to 2200) and per night (2200 to 0700) periods.

The NEF values may be interpreted in terms of land-use compatibility and expected community response in residential areas. Appendix D suggests land-use interpretations of NEF values and also estimates expected community response.

The NEF values may be used:

a) As guides in planning land use, land zoning and airport development.

b) For determining the relative merits of possible aircraft/engine changes and flight path changes in reducing the total noise exposure in the vicinity of an airport.

c) As part of airport/community programs to control the total noise exposure in specified areas.

B. HISTORICAL DEVELOPMENT OF THE NEF CONCEPT

For almost two decades the increasing magnitude of aircraft operations has brought increased concern over the noise aircraft produced in the surrounding communities. During most of the 1950's almost all of the jet aircraft were operated by the military agencies. Concern over the aircraft noise prompted the Air Force to conduct a series of major studies on the noise characteristics of jets, methods of control, and the effect of the jet noise on the communities surrounding the air bases. These studies established the operational framework for investigation and identified the fundamental parameters which affected community response to noise. Many variatons and refinements have been made since these original studies, yet essentially all existing models of aircraft-to-community relationships relate directly to the original work conducted by the Air Force.

The NEF procedures used today to assess the aircraft noise - community relationships have evolved from the predecessor Composite Noise Ratings (CNR) which have been widely used in this country as aids in land-use planning both around military air bases and community airports. A description of the CNR procedures and interpretations in terms of community response are described in detail in Ref. 6.

There are four basic developments which led to the current version of the Noise Exposure Forecasts. The first phase goes back to 1952 with the initial publication of the CNR concept by Rosenblith

and Stevens [Ref. 3]. In this publication and a subsequent modification [Ref. 4] the concepts which related aircraft noise to community response were established. In all the refinements since that time, no major elements have been introduced into the concept of community response, that were not originally envisioned in these first papers.

The next major step came in 1957 in a study done by Stevens and Pietrasanta [Ref. 5]. This evolution was primarily concerned with predicting the noise from a number of separate operations and then combining them to obtain a single number rating for the noise environment produced by the combination of aircraft operations.

In 1963, Galloway and Pietrasanta [Ref. 6] introduced the concept of perceived noise level for the measure of noise produced by a given aircraft. The perceived noise level (PNL), reported in PNdb, was a measure which related the physical measure of noise to the perceived judgement of the annoyance of that noise.

Bishop and Horonjeff [Ref. 7], in 1967, further modified the techniques to produce a new set of procedures which came to be known as Noise Exposure Forecasts. The main differences between the CNR and NEF calculations were in the transition from the perceived noise level (PNL) in the CNR to the effective perceived noise level (EPNL) in the NEF studies and the adjustment of certain constants so that there would be no confusion between the numerical results of the two methods.

The effective perceived noise level (EPNL) method of identifying the noise signature of an aircraft involves interrelated spectral, temporal and spatial functions of sound pressure. The measure is complex in that it addresses not only the effects of frequency and level but also the corrections for strong tones and long durations. This method is considered to be the best current state-of-the-art by the FAA Office of Noise Abatement. A detailed description and example of how to obtain EPNL values are given in Ref. 12.

A detailed account of the evolutionary steps from the original CNR concept to the present NEF concept can be found in Ref. 8.

III. PROGRAM USAGE

The computer program which was used to obtain the NEF contours was obtained from Ref. 10 and was adapted to the NPS IBM 360-67 computer. The program was run with sample data and compared to the sample results as listed in Ref. 10 to insure the validity of the routine. This section gives a brief description of the types of data necessary to compute the NEF contours for a specific airport. To compute the NEF contour distances, data on aircraft noise, performance, and volume of activity must be specified and read by the program.

The data concerning aircraft noise ~~is~~ are described in terms of effective perceived noise level (EPNL). An EPNL vs. Aircraft-to-Observer Slant Distance function is specified in terms of a list of EPNL values at various slant distances. These functions are specified in figures A-1 through A-8 of Ref. 9.

The aircraft performance data is described in terms of an Altitude Profile and a Delta-EPNL profile. The Altitude Profile consists of a list of X, Y values which describe the flight paths for take off and landing. The X value is a position along the ground under the specified flight track in relation to a reference point (in this case the reference point is the starting point on the runway for the take off roll) and the Y value is the altitude of the aircraft at the associated X

value. Table A-1 of Ref. 9 lists the appropriate take off profiles and EPNL vs. distance curves to use for each appropriate aircraft class. This table also lists examples of which aircraft belong to which class.

The Delta-EPNL Profile also consists of a list of X, Y values. This profile allows the programmer to modify the noise characteristics of the aircraft as a function of position along the flight track. This profile is useful for investigating procedures such as power cut backs along the flight path.

The volume of activity is specified as the average number of specific aircraft movements (take offs and landings), broken down into aircraft classes in each of two time periods (0700 to 2200 and 2200 to 0700).

The required data is prepared on punched cards for program usage. A unique format is required for each type of data information. Descriptions and examples of this information are given in detail in Ref. 10.

IV. PROCEDURES FOR COMPUTING NEF CONTOURS

The problem of defining the position or distance from the flight track at which a specific NEF contour occurs is a tedious, interpolative procedure which suggests computer computation. The program in Ref. 10 generates the perpendicular distance from a given flight track to a specified NEF value at selected distances along the track. The coordinates given in the computer output are then plotted along the perpendiculars of the projected flight path, which may or may not be curved. If there are any intersecting or merging flight tracks the resulting contours are smoothed by the draftsman.

The total noise exposure at a particular point is the result of the effective perceived noise levels produced by different aircraft flying along different flight paths. For aircraft class i on flight path j, the NEF(ij) is expressed as

$$NEF(ij) = EPNL(ij) + 10 \log \left[\frac{N(day)\ (ij)}{K(day)} + \frac{N(night)\ (ij)}{K(night)} \right] - C$$

where

NEF(ij) = NEF value from aircraft class (i) along flight path (j).

EPNL(ij) = effective perceived noise level produced by aircraft class (i) along flight path (j),

K = normalizing constant used to adjust the NEF values to reflect volume of operations during daytime and nighttime periods.

C = an arbitrary normalizing constant.

K(day) is selected so that for 20 movements of a given aircraft per daytime period, the resulting correction is zero.

$$10 \log \frac{20}{K(\text{day})} = 0 \quad ; \quad K(\text{day}) = 20$$

K(night) is chosen so that for the average number of operations per hour during daytime or nighttime periods the NEF value for nighttime operations could be 10 units higher than for daytime operations. This correction was made after several studies in selected residential communities indicated the ambient noise level was approximately 10 decibels less during the nighttime hours than during the daytime [Ref. 13]. Hence,

$$10 = 10 \log \left[\frac{K(\text{day})}{K(\text{night})} \cdot \frac{9}{15} \right] \quad ; \quad K(\text{night}) = 1.2$$

where 9 and 15 are the numbers of hours in the day (0700-2200) and night (2200-0700) periods respectively.

The value for C is arbitrarily set at 75. The primary reason for using this constant is so there will be a significant difference between the EPNL values and the NEF values and no confusion will result between the two.

Using the above values for K and C the original equation becomes

$$\text{NEF(ij)} = \text{EPNL(ij)} + 10 \log \left[\text{N(day)(ij)} + 16.67\ \text{N(night)(ij)} \right] - 88.$$

The resulting total NEF at a particular ground position should be thought of as an "energy" summation of all the individual NEF(ij) values.

$$\text{NEF} = 10 \log \sum_i \sum_j \text{antilog} \frac{\text{NEF (ij)}}{10} .$$

The reason it is thought of as an energy summation is because each individual aircraft flying along each flight path adds to the cumulative total annoyance.

The computer program was set up to handle any mix of the aircraft classes as described in Appendix E. As long as these types of aircraft continue to be used by the airlines, military, and business executives in Monterey, the only variables which determine the NEF contours are the volume of operations, time of day, and flight profiles. By just varying these parameters any number of possible options can be readily evaluated.

The two scenarios presented in this paper are first, a situation where all aircraft land on runway 10 using a straight in instrument approach and all aircraft take off on runway 28, one half of them (those north bound) using a Bay Two departure [Appendix F] and the other half (those south bound) using a straight out departure. The second scenario again has all aircraft making a straight in approach to runway 10 but differs from the first by having all departing aircraft adhere to the Bay Two departure procedures. [see Appendix B]

The first scenario reflects the present operational procedure at the Monterey airport. The reduction of residential area inside the noise impact boundary is substantial when all departing aircraft follow the Bay Two departure as in the second scenario. Without any other noise abatement procedures, this single change would result in an immediate improvement.

The program requires the volume of operations data to be the average daily number of flights for each aircraft class in the daytime and nighttime periods. For the purpose of this analysis the data was obtained from the June, 1973, FAA monthly operations summary. Because this form does not specify the type of aircraft class, it was necessary to extrapolate the appropriate data from airline schedules, landing fee revenues, and "best guesses" from the airport manager.

It was necessary to include "best guess" type data because the FAA does not keep track of aircraft by class and the airport management only records those flights which produce landing fee revenues. The data for the two, three and four engine jets, which account~~s~~ for the majority of the noise, ~~is~~ are obtained primarily from the airline schedules and scheduled MEDIVAC military aircraft. The airport records do not reflect the unscheduled airline training flights, the unscheduled military flights or the private corporate jets.

It was not the intent of this paper to predict the future volume of operations at the Monterey airport. The program is capable, however,

of determining the appropriate NEF contours for any specified volume of operations or aircraft mix. Appendix C depicts the same two scenarios as mentioned above, the only difference being that the volume of operations data was doubled. This would be the situation in a matter of several years if the air density continued to grow at the approximate yearly rate of 14% as it has over the past four years. There is also the possibility of additional scheduled air carriers if an intra-state airline begins to serve the Monterey Peninsula. These results point out the need for continued research to develop quieter engines, an increased use of the newer and quieter airplanes, a willingness to accept fewer flights, or accepting an ever increasing noise level.

Once the proper altitude, delta-EPNL, and EPNL profiles are determined and read into the program, the only other parameter needed is the volume of operations for each segment of the flight path. This data is subdivided into aircraft class, daytime or nighttime, and also trip length. Trip length category one is arbitrarily assigned for landings and the other categories are for flights of less than 500 miles and increasing in 500 mile increments to category eight which is for flights of between 3000 and 3500 miles. The data is divided in this manner to account for the heavier fuel loads necessary for longer flights. The input data for the volume of operations which were used in this compilation are listed in Appendix A.

In order to plot the NEF contours around the Monterey airport it was necessary to compute the perpendicular sideline distances in five separate segments. The coordinate values for each segment are shown on pages 35 through 39. Each segment was then plotted and combined to form the resulting NEF contours. Where the flight paths merged or intersected the contours were adjusted to present a smooth, consistent appearance.

Although what has been called "best guess" type data was included in the analysis it can be seen by comparing the output data on page 40 which was computed using only the scheduled air carriers, with that on page 39 which is for all aircraft (including "best guess") that the scheduled airliners account for most of the noise impact.

V. DISCUSSION

The purpose of this report was to determine whether or not the Monterey Peninsula airport had a noise pollution problem as defined by the California Noise Standards, or if it will have one when the Environmental Protection Agency announces the acceptable noise levels in October of 1973. The contours in Appendix B, which are for the present (June, 1973) level of operations, indicate that there are significant residential areas which lie inside the noise impact boundary. The task of reducing the noise level has been assigned to the airport management, but to have a realistic solution it will require the mutual support of the airlines, FAA, research and development, and the general public.

Because of the approximations made in the computer routine, any NEF contour as shown in the Appendixes can be considered the boundary for the one adjacent to it. (Consider the contours accurate to within plus or minus five units on the NEF scale) By observing the residential areas which lie inside the varying contours, one can see that it is already too late for appropriate land use zoning in some areas. In the future, however, for any development a primary consideration should be the noise impact on the area. The guidelines for acceptable usage are listed in Appendix D. These are meant to be only guidelines and

with proper construction in regards to noise dampening the usable area, whether for residential, industrial, or recreation may be increased.

In addition to the reported 14% yearly increase in flight activity at the Monterey airport there are other reasons to believe the flight density will continue to grow. Just one of these is the desire to build a convention center in downtown Monterey. Since air travel is the accepted form of transportation for convention goers, this in itself, if it is indeed realized, would result in a substantial increase in the demand for air service to the community.

The computer program which was used to compute the NEF contours has several shortcomings in its applicability to the Monterey airport. The most significant ones are the failures to account for the sound attenuation and reflection because of the terrain features in the area and the disregarded effect of the thrust reversers used by the air carriers because of the relatively short runway. Both of these omissions result in conservative estimates of the noise impact boundaries. In order to determine the effects of the above factors it is recommended that noise measuring equipment be installed and monitored to verify the NEF contour plots. The California Department of Aeronautics will soon have a mobile van with monitoring capability that will be available to interested communities.

It is possible that in the future when the airport surveillance radar is installed it will be feasible for aircarriers to take off to the East and land to the West. Although this would greatly reduce the residential areas now affected by the airport traffic, it would necessitate strict zoning and land use planning in the now relatively unpopulated area east of the airport.

If the Monterey airport is to remain in its present location, which is a convenience because of the proximity to the community, the solution of the noise problem seems to rest with the development and use of the newer and quieter aircraft. It is an economic infeasibility to expect the airlines to do this immediately while they still have years of service left on the present generation of airplanes, unless the public is willing to absorb the enormous costs of converting a fleet of 727's to the newer and quieter aircraft like the DC-10. This suggests an altogether different area of possible inquiry. Since it is generally assumed that the airport exists to serve the community, a need arises to determine exactly which segment of the community the airport does serve, who derives the benefits and who pays the social costs in terms of noise annoyance.

APPENDIX A

Volume of Operations Input Data

In order to plot the contours for the Monterey airport it was necessary to divide the volume of operations data into five segments. For the first scenario where all the landings are straight in and one half of the take offs are straight out and the other half follow the Bay Two departure procedure there are three separate areas, which to be plotted require different aircraft flight density input data. The area in the vicinity of the runway is affected by all the aircraft movements whereas the area West of the runway is affected by landing aircraft and one half of the takeoffs and that area North-West of the runway is influenced only by one half of the take offs. For the second scenario the area around the airport is again affected by all the aircraft but the area to the West is only influenced by landing aircraft and that area North-West is concerned with all the take off aircraft.

The input for the analysis of present operations is the appropriate subdivision of currently used aircraft by trip length category and time period for operations. Appendix E shows the five aircraft classes which were considered in determining the NEF contours and also lists examples of which aircraft belong to each class. The June, 1973 volume of operations data for each of the five aircraft classes was

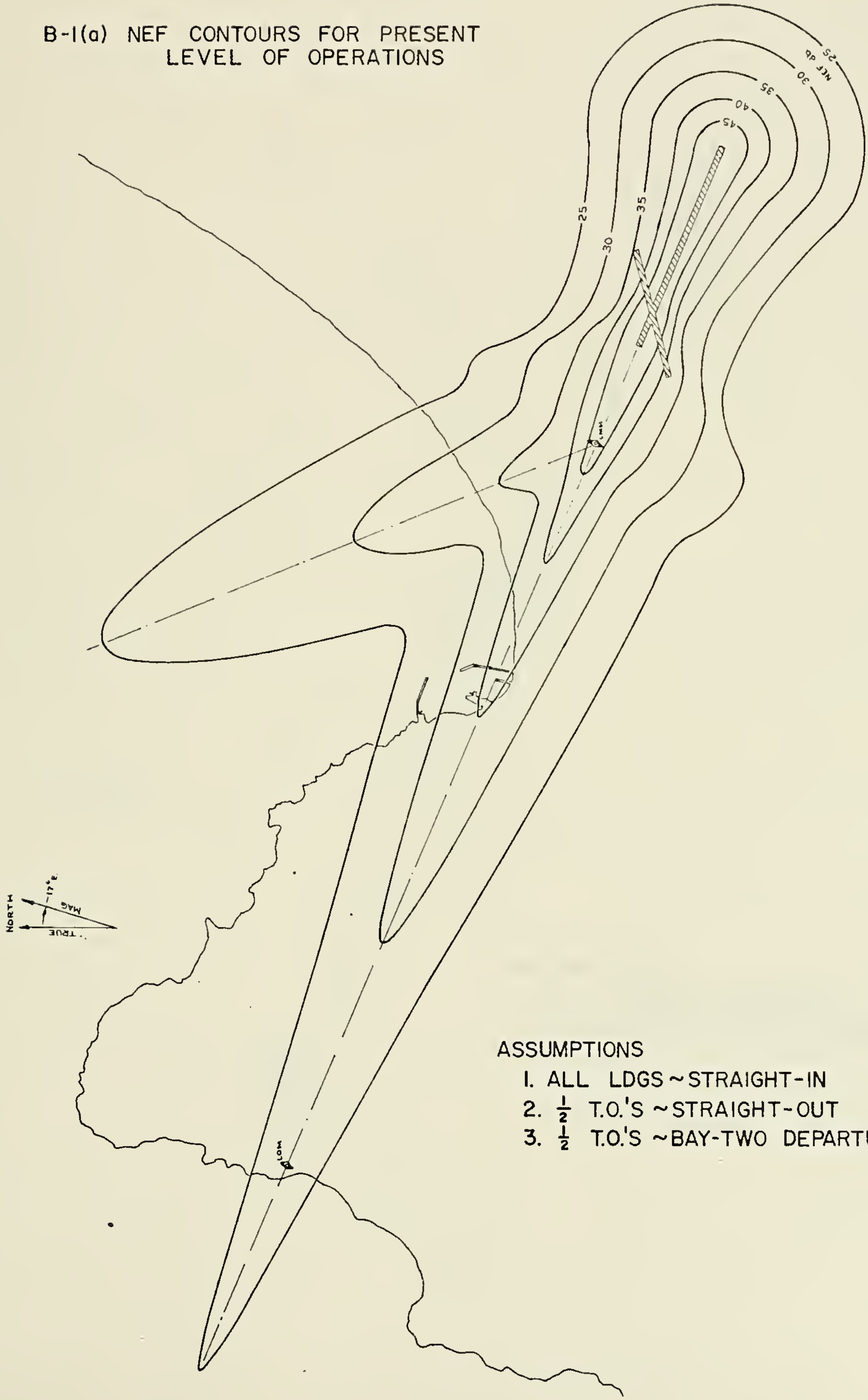
reduced to a daily average for computer input. The following is a listing of the relevant input:

Aircraft Class	Volume of Operations	
	Daytime Average	Nighttime Average
4 engine jet	0.4	0
2 or 3 engine jet	13.3	3.0
executive jet	3.0	0.5
4 engine prop	2.0	0.5
2 engine prop	2.0	0

The contours in Appendix C were obtained in the same manner as those in Appendix B, the only difference being that the volume of operations data was doubled.

APPENDIX B

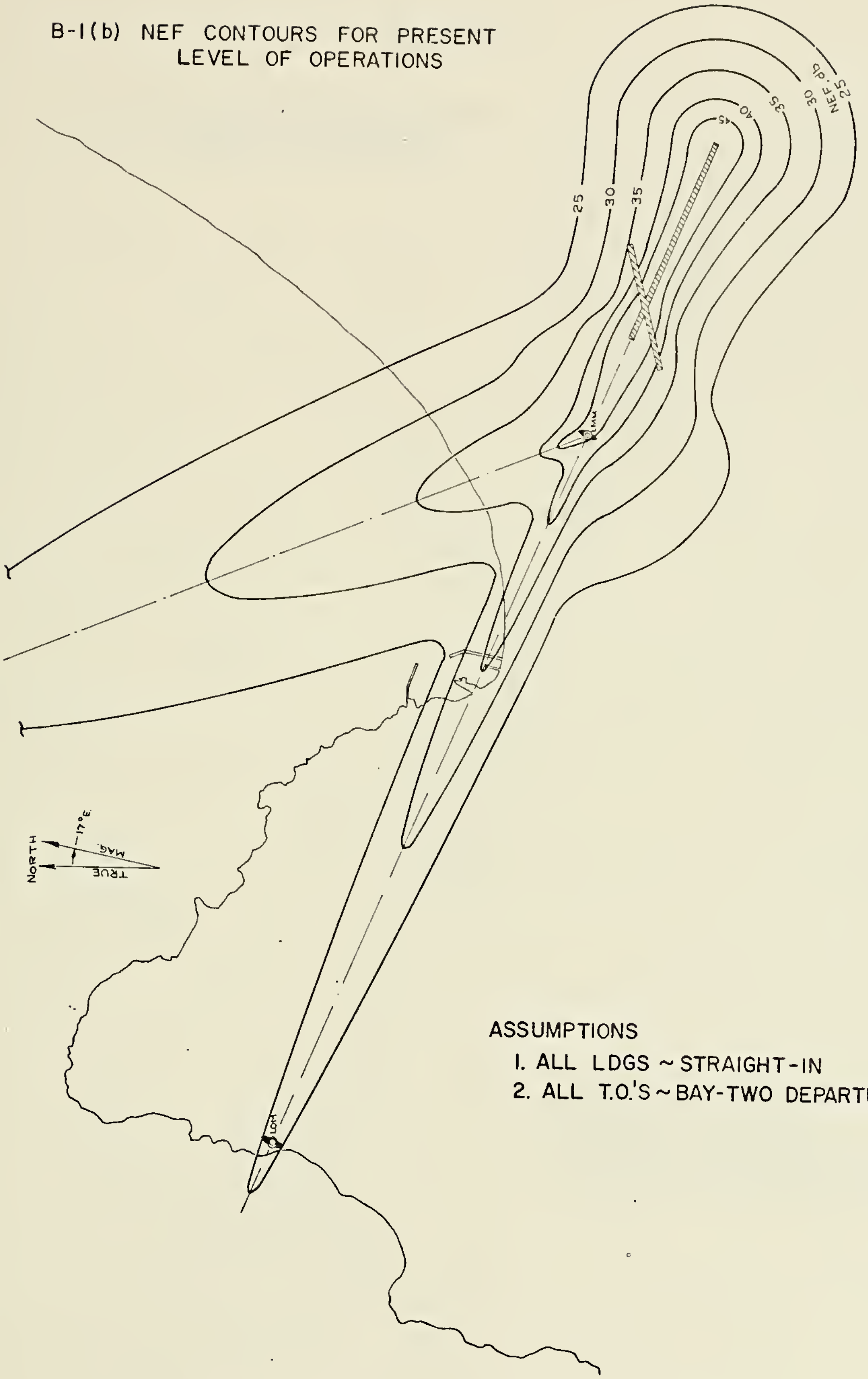
B-1(a) NEF CONTOURS FOR PRESENT LEVEL OF OPERATIONS



ASSUMPTIONS

1. ALL LDGS ~ STRAIGHT-IN
2. $\frac{1}{2}$ T.O.'S ~ STRAIGHT-OUT
3. $\frac{1}{2}$ T.O.'S ~ BAY-TWO DEPARTURE

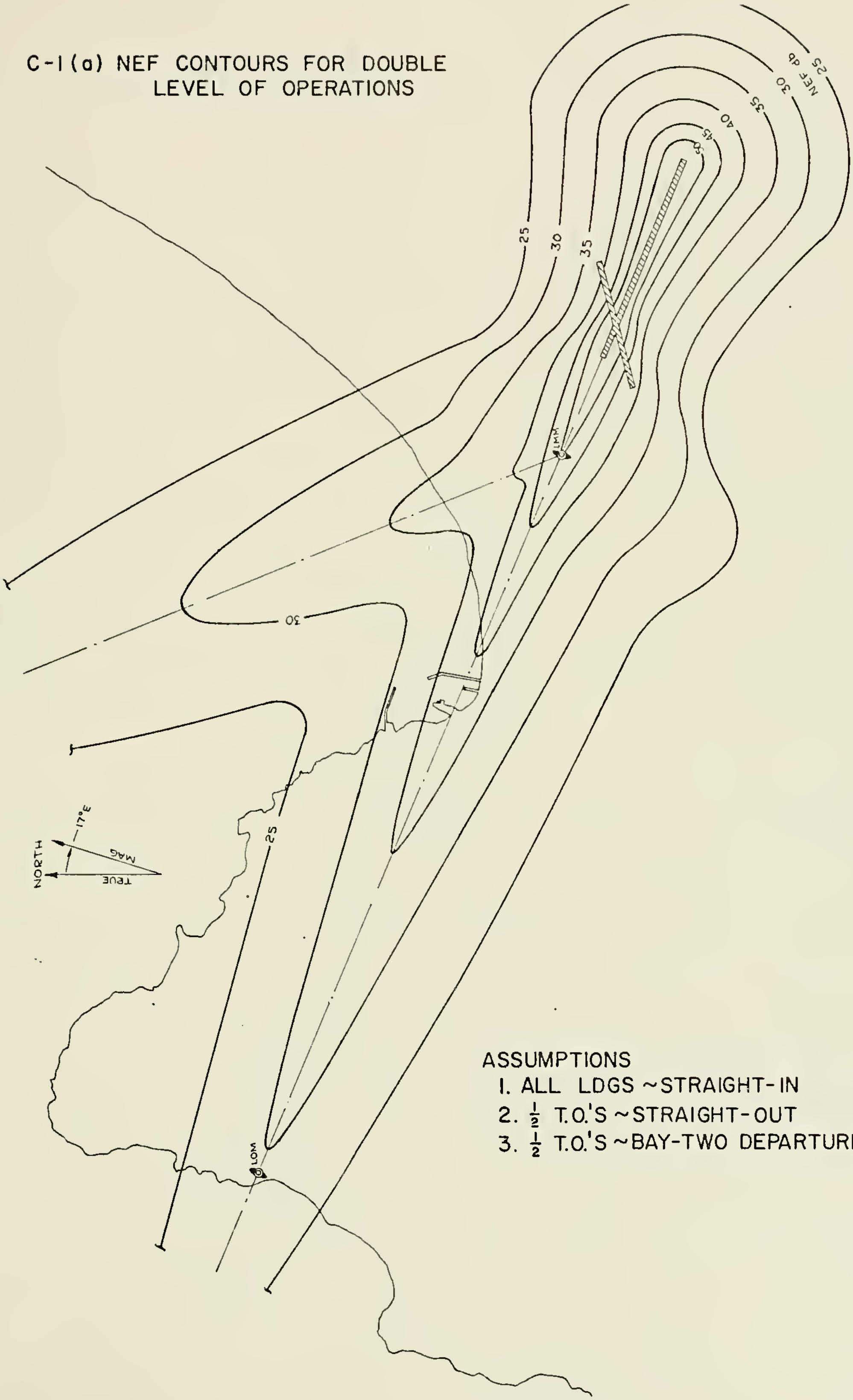
B-1(b) NEF CONTOURS FOR PRESENT LEVEL OF OPERATIONS



ASSUMPTIONS
1. ALL LDGS ~ STRAIGHT-IN
2. ALL T.O.'S ~ BAY-TWO DEPARTURE

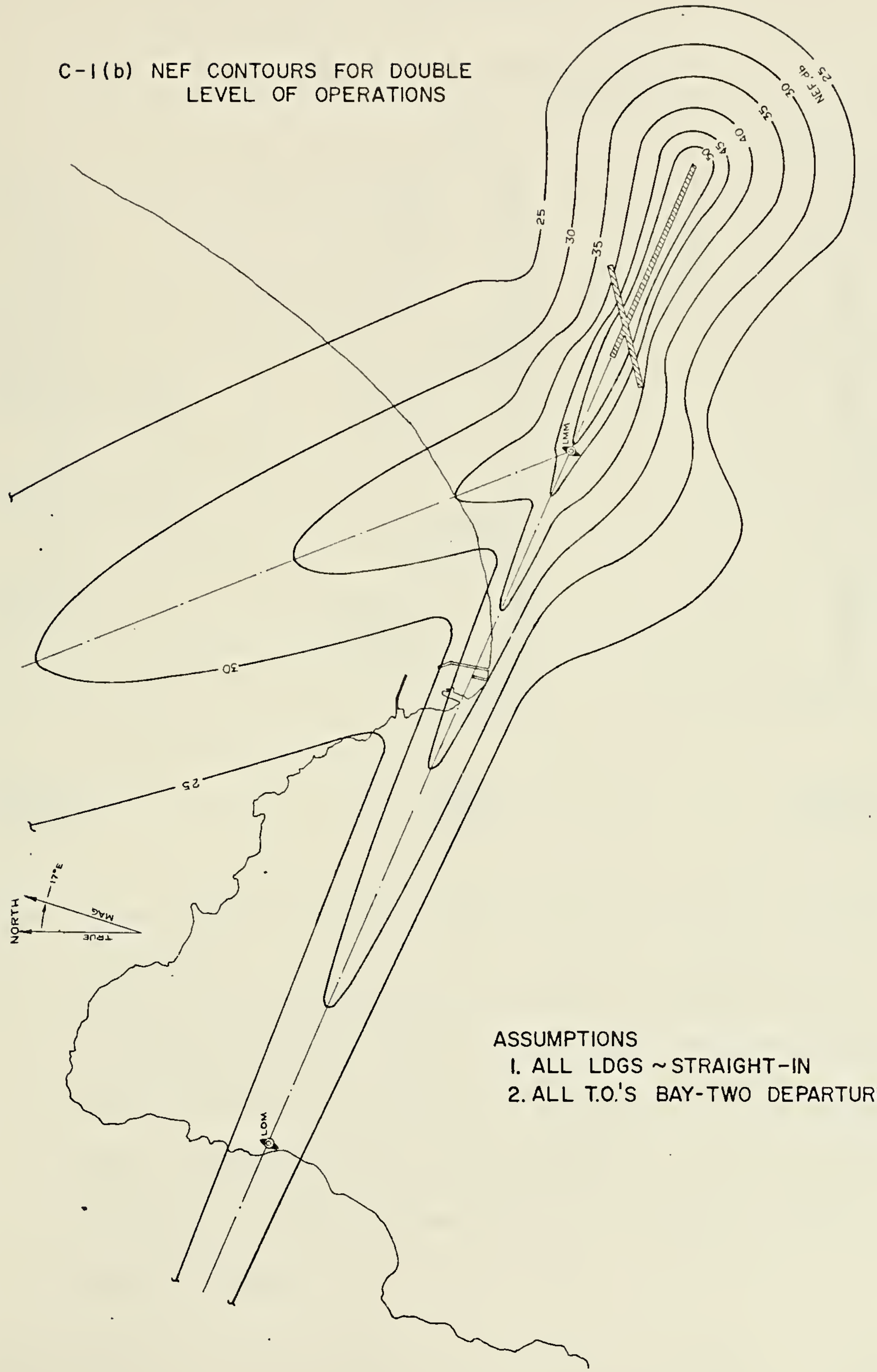
APPENDIX C

C-1(a) NEF CONTOURS FOR DOUBLE LEVEL OF OPERATIONS



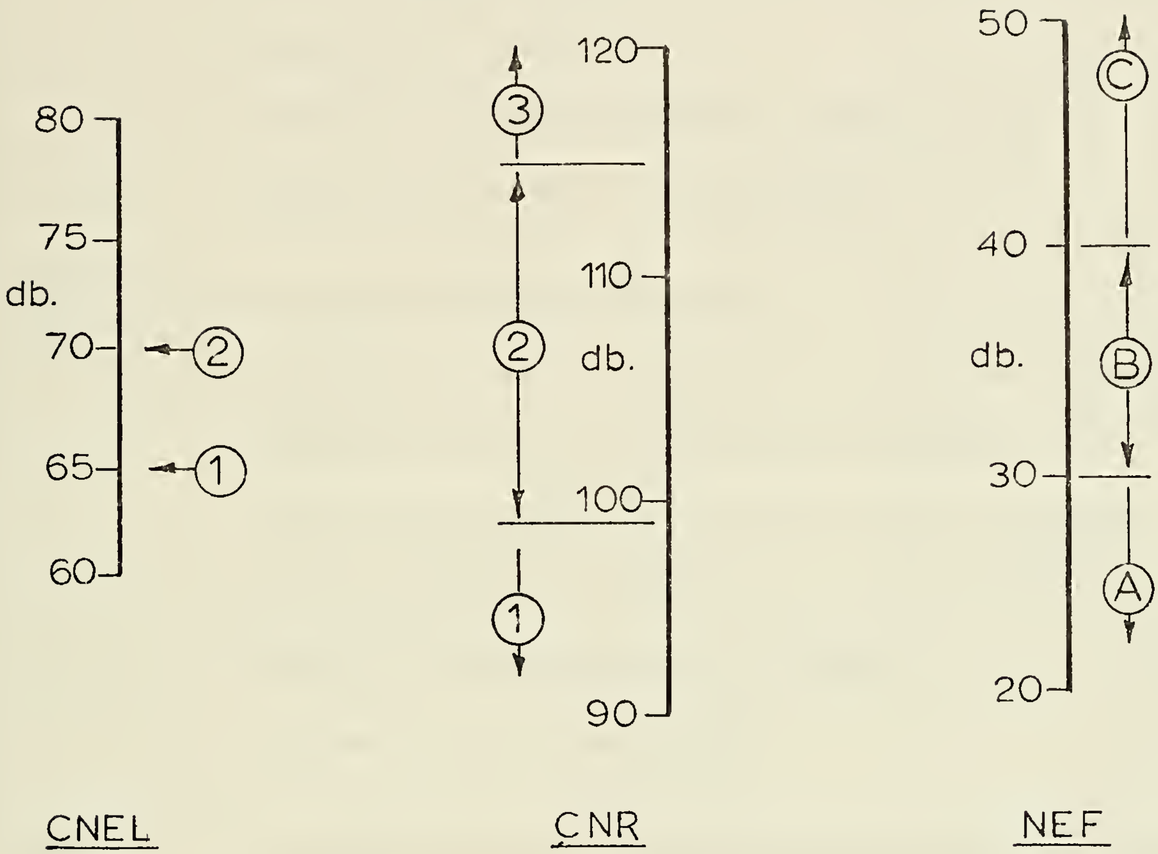
ASSUMPTIONS
1. ALL LDGS ~STRAIGHT-IN
2. $\frac{1}{2}$ T.O.'S ~STRAIGHT-OUT
3. $\frac{1}{2}$ T.O.'S ~BAY-TWO DEPARTURE

C-1(b) NEF CONTOURS FOR DOUBLE LEVEL OF OPERATIONS



APPENDIX D

NOISE SCALE COMPARISONS



Note: For comparative purposes between the above three methods, the relative vertical alignment of the scales shows their relationships to each other. The interpretations listed below are heuristic and are meant to be guidelines for land use planning. Each community may select higher or lower standards, depending on ambient noise levels, style of living or other pertinent factors.

<u>CNR</u> 1 Essentially no complaints expected, but the noise may occasionally interfere with certain activities of some residents.

2 Individuals may complain, perhaps vigorously; concerted group action is possible.

3 Individual reactions will include repeated, vigorous complaints. Group action is probable.

<u>NEF</u> A No problems with residential use.

B Individuals in private residences may complain, perhaps vigorously; concerted group action is possible. New single-family dwelling construction should be avoided. If apartments are constructed, noise control features should be incorporated in their design.

C Residential use is incompatible.

<u>CNEL</u> 1 Recommended limit for residential use (normal construction), for new airports and for all existing airports after 1985.

2 Recommended interim limit for residential use (normal construction), for existing airports.

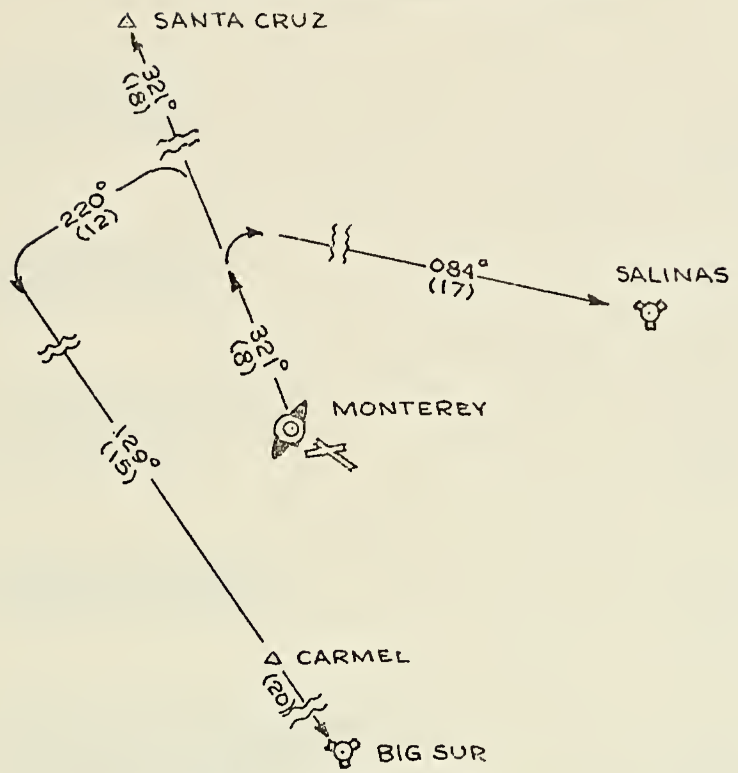
APPENDIX E

AIRCRAFT TYPE EXAMPLES

Aircraft Type	Examples
Large four engine turbofan transports (standard and stretched)	Boeing 707-320 B, C Douglas DC-8-50
Two and three engine turbofan transports	Boeing 727 Boeing 737 Douglas DC-9 BAC 111
General aviation turbojet aircraft	Lockheed Jetstar North American Saberliner Lear Jet Jet Commander Grumman Gulfstream II
Four engine piston and turboprop aircraft	Convair 340, 440 series Douglas DC-3 Fairchild F-27 series Grumman Gulfstream I

APPENDIX F

BAY TWO DEPARTURE



DEPARTURE ROUTE DESCRIPTION

RWY 28: Climb on runway heading to 500′ then turn right;

RWY 6 and 10: Turn left as soon as practicable, climb direct to MONTEREY LMM, then turn right;

RWY 24: Turn right as soon as practicable, climb direct to MONTEREY LMM;

VIA 321° course from MONTEREY LMM to intercept transition or assigned route.

BIG SUR TRANSITION: After reaching 3000′ turn left to 220° heading to intercept and proceed via BIG SUR 309 radial to BIG SUR VORTAC. Cross CARMEL INTXN at or above 6000′.

SALINAS TRANSITION: After reaching 2000′ turn right to 010° heading to intercept and proceed via SALINAS 264 radial to SALINAS VORTAC.

SANTA CRUZ TRANSITION: Continue out NAVY MONTEREY TACAN 321 radial to intercept V-25 at SANTA CRUZ INTXN at or above 5000.

MONTEREY NO LNDS--ONE HALF T/O BAY TWO

DISTANCE TO CONTOUR IN FEET

POINT ON FLIGHT TRACK	25	30	35	40	45	50	55
0	3633	2607	1685	985	536	222	118
1000	3312	2279	1437	816	433	199	91
2000	2975	1981	1210	673	295	156	71
3000	2634	1707	1002	549	229	123	57
4000	2311	1461	833	444	200	96	47
5000	2123	1319	741	385	244	178	81
6000	2111	1310	903	684	357	157	45
7000	2462	1925	1199	649	283	26	0
8000	3253	1994	1155	561	61	0	
9000	3348	1951	1081	400	0		
10000	3315	1894	978	0			
11000	3274	1821	831				
12000	3224	1730	612				
13000	3164	1617	110				
14000	3094	1477	0				
15000	3014	1302					
16000	2922	1075					
17000	2817	750					
18000	2698	0					
19000	2563						
20000	2409						
21000	2233						
22000	2028						
23000	1785						
24000	1486						
25000	1085						
26000	304						
27000	0						
CONTOUR CLOSING POINT ON FLIGHT TRACK	26083	17883	13028	9828	8108	7107	6322

MONTEREY ALL LNDS STR IN--ONE HALF T/C STR CUT

POINT ON FLIGHT TRACK	DISTANCE TO CONTOUR IN FEET 25	30	35	40	45	50	55
0	3684	2652	1725	1028	577	262	137
1000	3375	2345	1497	873	487	218	114
2000	3082	2067	1299	751	416	199	97
3000	2768	1824	1125	657	358	175	84
4000	2506	1623	987	582	300	155	75
5000	2346	1515	920	544	298	207	106
6000	2336	1508	987	726	424	210	87
7000	2565	1978	1287	734	385	146	0
8000	3297	2101	1253	680	311	48	
9000	3446	2066	1197	606	222	0	
10000	3417	2019	1125	516	110		
11000	3381	1962	1035	426	0		
12000	3338	1892	932	335			
13000	3286	1811	823	228			
14000	3226	1719	717	0			
15000	3158	1616	620				
16000	3082	1507	525				
17000	2996	1396	422				
18000	2903	1287	295				
19000	2800	1181	0				
20000	2689	1076					
21000	2571	975					
22000	2446	866					
23000	2315	753					
24000	2177	630					
25000	2038	481					
26000	1900	268					
27000	1765	0					
28000	1639						
29000	1516						
30000	1396						
CONTOUR CLOSING POINT ON FLIGHT TRACK		26462	18964	13880	10346	8146	6986

MONTEREY NC LNDS--ALL T/O BAY TWO

DISTANCE TO CONTOUR IN FEET

POINT ON FLIGHT TRACK	25	30	35	40	45	50	55
0	4327	3246	2208	1383	780	411	188
1000	3929	2894	1915	1159	643	277	147
2000	3580	2562	1650	959	522	215	115
3000	3268	2234	1403	796	421	194	89
4000	2929	1943	1181	658	287	152	70
5000	2720	1775	1053	579	291	220	131
6000	2708	1764	1091	806	537	266	103
7000	2839	2230	1632	945	492	160	0
8000	3625	2773	1600	887	372	0	
9000	4483	2745	1546	792	0		
10000	4459	2702	1475	645			
11000	4430	2652	1380	394			
12000	4395	2590	1257	0			
13000	4352	2515	1097				
14000	4301	2427	879				
15000	4244	2324	541				
16000	4179	2203	0				
17000	4106	2063					
18000	4025	1897					
19000	3936	1700					
20000	3837	1458					
21000	3728	1145					
22000	3608	665					
23000	3477	0					
24000	3332						
25000	3172						
26000	2994						
27000	2796						
28000	2571						
29000	2314						
30000	2011						
CONTOUR CLOSING POINT ON FLIGHT TRACK		22494	15577	11542	8984	7679	6778

MONTEREY ONLY LNDS (STR IN)

POINT ON FLIGHT TRACK	25	30	35	40	45	50	55
		DISTANCE TO CONTOUR IN FEET					
0	1434	952	625	381	206	105	54
1000	1434	952	625	381	206	105	54
2000	1434	952	625	381	206	105	54
3000	1434	952	625	381	206	105	54
4000	1434	952	625	381	206	105	54
5000	1434	952	625	381	206	105	54
6000	1434	952	625	381	206	103	50
7000	1433	949	621	374	194	78	0
8000	1429	944	613	361	165	0	
9000	1424	935	600	338	108		
10000	1416	924	582	305	0		
11000	1407	909	559	258			
12000	1395	892	529	185			
13000	1382	870	492	0			
14000	1366	845	446				
15000	1348	816	388				
16000	1328	782	311				
17000	1305	743	192				
18000	1280	698	0				
19000	1252	645					
20000	1221	583					
21000	1187	508					
22000	1150	414					
23000	1109	281					
24000	1064	0					
25000	1014						
26000	959						
27000	897						
28000	827						
29000	748						
30000	654						
CONTOUR CLOSING POINT ON FLIGHT TRACK		23808	17547	12920	9613	7696	6773

MONTEREY ALL SAME PATH

POINT ON FLIGHT TRACK	DISTANCE TO CONTOUR IN FEET 25	30	35	40	45	50	55
0	4337	3267	2231	1405	801	430	199
1000	3972	2930	1946	1193	672	307	163
2000	3633	2608	1691	1004	564	256	134
3000	3333	2303	1466	855	477	214	113
4000	3038	2034	1276	738	409	199	96
5000	2847	1884	1167	679	372	235	149
6000	2836	1875	1161	836	576	301	130
7000	2917	2271	1681	992	541	235	44
8000	3658	2827	1652	944	459	114	0
9000	4498	2800	1604	869	345	0	
10000	4474	2761	1543	768	222		
11000	4446	2714	1465	649	0		
12000	4412	2658	1369	525			
13000	4369	2590	1256	391			
14000	4320	2512	1126	238			
15000	4265	2422	981	0			
16000	4204	2318	834				
17000	4139	2202	692				
18000	4074	2072	553				
19000	4011	1929	400				
20000	3937	1774	180				
21000	3839	1610	0				
22000	3733	1442					
23000	3618	1276					
24000	3495	1112					
25000	3363	953					
26000	3222	793					
27000	3072	619					
28000	2914	393					
29000	2746	0					
30000	2572						
CONTOUR CLOSING POINT ON FLIGHT TRACK		28700	20268	14696	10945	8524	7261

MONTEREY ONLY SCHED. ALL SAME PATH

DISTANCE TO CONTOUR IN FEET

POINT ON FLIGHT TRACK	25	30	35	40	45	50	55
0	3992	2923	2017	1270	704	362	165
1000	3630	2628	1759	1060	587	294	132
2000	3305	2343	1532	891	490	240	108
3000	2999	2079	1328	759	413	199	90
4000	2716	1839	1145	659	355	170	78
5000	2564	1710	1048	609	330	231	140
6000	2562	1708	1092	810	551	286	120
7000	2751	2199	1613	950	514	218	0
8000	3580	2711	1582	901	430	84	
9000	4321	2683	1536	823	313	0	
10000	4297	2646	1472	718	187		
11000	4267	2597	1390	598	0		
12000	4232	2537	1289	471			
13000	4190	2466	1171	341			
14000	4143	2382	1032	171			
15000	4093	2286	886	0			
16000	4043	2176	741				
17000	3990	2052	601				
18000	3910	1913	461				
19000	3823	1761	296				
20000	3727	1598	0				
21000	3623	1429					
22000	3510	1264					
23000	3387	1108					
24000	3254	955					
25000	3112	800					
26000	2960	629					
27000	2797	407					
28000	2626	0					
29000	2448						
30000	2266						
CONTOUR CLOSING POINT ON FLIGHT TRACK		27788	19759	14391	10735	8314	6982

```
C
C
C     NEF CONTOUR CONTROL ROUTINE
C
C     PURPOSE
C       TO COMPUTE THE COORDINATES OF NEF CONTOURS AS A FUNCTION
C       OF AIRCRAFT FLIGHT PATH PARAMETERS AND AIRCRAFT PERFORMANCE
C
C     DESCRIPTION OF PARAMETERS
C     XSTART - LOCATION ON FLIGHT PATH TO START
C              CONTOUR COMPUTATIONS (REAL)
C     XEND - LOCATION ON FLIGHT PATH TO END
C            CONTOUR COMPUTATIONS (REAL)
C     DX - INTERVAL ALONG FLIGHT PATH BETWEEN
C          CONTOUR COMPUTATIONS (REAL)
C     NAC - NUMBER OF UNIQUE AIRCRAFT TYPES (INTEGER)
C     CONTUR - VALUE OF NEF CONTOUR CURRENTLY
C              BEING COMPUTED (REAL)
C     NTET(I) - TOTAL NUMBER OF CURRENT ENTRIES
C     IN DATA TABLES (INTEGER)
C        I = 1 - AIRCRAFT DESCRIPTOR TABLE
C            2 - ALTITUDE PROFILE TABLE
C            3 - DELTA-EPNL PROFILE TABLE
C            4 - EPNL PROFILE TABLE
C     NFET(I) - NUMBER OF ENTRIES IN DATA
C               TABLES WHICH ARE FIXED AND MAY NOT
C               BE DELETED (INTEGER)
C        I = 1 - AIRCRAFT DESCRIPTOR TABLE
C            2 - ALTITUDE PROFILE TABLE
C            3 - DELTA-EPNL PROFILE TABLE
C            4 - EPNL PROFILE TABLE
C     NMHX(I) - MAXIMUM ALLOWABLE NUMBER OF ENTRIES
C               IN THE VARIOUS DATA TABLES (INTEGER)
C        I = 1 - AIRCRAFT DESCRIPTOR TABLE
C            2 - ALTITUDE PROFILE TABLE
C            3 - DELTA-EPNL PROFILE TABLE
C            4 - EPNL PROFILE TABLE
C     DSCNAM(I) - NUMERIC NAME OF THE I-TH ENTRY IN
C                 THE AIRCRAFT DESCRIPTOR TABLE (INTEGER)
C     DSCRPT(J,I) - 12 CHARACTER ALPHANUMERIC
C                   AIRCRAFT DESCRIPTOR FOR THE I-TH
C                   ENTRY IN THE AIRCRAFT CLASS
C                   DESCRIPTOR TABLE. J IS DIMENSIONED FOR 3 TO
C                   ALLOW FOR THE 12 CHARACTERS. (INTEGER)
C     ALTDIR(J,I) - DIRECTORY WHICH CONTAINS THE NUMERIC NAMES OF
C                   ALTITUDE PROFILES USED BY THE I-TH ENTRY IN
C                   THE AIRCRAFT CLASS DESCRIPTOR TABLE FOR THE
C                   J-TH TRIP LENGTH CATEGORY. (INTEGER)
```

```
C          POWDIR(J,I) - DIRECTORY WHICH CONTAINS THE NUMERIC NAMES OF
C                        DELTA-EPNL PROFILES USED BY THE I-TH ENTRY IN
C                        THE AIRCRAFT CLASS DESCRIPTOR TABLE FOR THE
C                        J-TH TRIP LENGTH CATEGORY. (INTEGER)
C          EPNDIR(J,I) - DIRECTORY WHICH CONTAINS THE NUMERIC NAMES OF
C                        EPNL PROFILES USED BY THE I-TH ENTRY IN THE
C                        AIRCRAFT CLASS DESCRIPTOR TABLE FOR THE J-TH
C                        TRIP LENGTH CATEGORY. (INTEGER)
C          ALTNAM(I) - NUMERIC NAME OF THE I-TH ENTRY IN THE ALTITUDE
C                      PROFILE TABLE. (INTEGER)
C          NALT(I) - NUMBER OF COORDINATES DEFINING THE I-TH ENTRY IN
C                    THE ALTITUDE TABLE. (INTEGER)
C          ALT(K,J,I) - THE ALTITUDE PROFILE VALUE FOR THE I-TH ENTRY
C                       IN THE TABLE FOR THE J-TH COORDINATE (1=X,2=Y)
C                       AND THE K-TH POINT IN THE PROFILE. (REAL)
C          Z(I) - THE ALTITUDE AT THE CURRENT POINT ON THE FLIGHT PATH,
C                 EVALUATED FROM THE I-TH ENTRY IN THE ALTITUDE
C                 PROFILE TABLE. (REAL)
C          POWNAM(I) - NUMERIC NAME OF THE I-TH ENTRY IN THE DELTA-EPNL
C                      PROFILE TABLE. (INTEGER)
C          NPOW(I) - NUMBER OF COORDINATES DEFINING THE I-TH ENTRY IN
C                    THE DELTA-EPNL TABLE. (INTEGER)
C          POWER(K,J,I) - THE DELTA-EPNL PROFILE VALUE FOR THE I-TH
C                         ENTRY IN THE TABLE FOR THE J-TH COORDINATE
C                         (1=X,2=Y) AND THE K-TH POINT IN THE PROFILE.
C                         (REAL)
C          POWSPL(I) - THE DELTA-EPNL VALUE AT THE CURRENT POINT ON THE
C                      FLIGHT PATH, EVALUATED FROM THE I-TH ENTRY IN
C                      THE DELTA-EPNL PROFILE TABLE. (REAL)
C          PNLNAM(I) - NUMERIC NAME OF THE I-TH ENTRY IN THE EPNL
C                      PROFILE TABLE. (INTEGER)
C          PNLEFF(K,J,I) - THE EPNL PROFILE VALUE FOR THE I-TH ENTRY IN
C                          THE TABLE FOR THE J-TH PROPAGATION PATH
C                          (1=GROUND-TO-GROUND,2=AIR-TO-GROUND) AND
C                          THE K-TH VALUE IN THE PROFILE
C          ACALC(I) - LIST OF ALTITUDE PROFILES REQUIRED FOR COMPUTING
C                     CONTOURS ON CURRENT FLIGHT PATH. (INTEGER)
C          PCALC(I) - LIST OF DELTA-EPNL PROFILES
C                     REQUIRED FOR COMPUTING CONTOUR ON CURRENT FLIGHT
C                     PATH. (INTEGER)
C          OPER(I) - NEF ADJUSTMENT FOR VOLUME OF OPERATIONS ASSOCIATED
C                    WITH THE I-TH UNIQUE AIRCRAFT TYPE. (REAL)
C          APTR(I) - POINTER TO THE ENTRY IN THE ALTITUDE PROFILE TABLE
C                    USED FOR THE I-TH UNIQUE AIRCRAFT TYPE. (INTEGER)
C          PPTR(I) . POINTER TO THE ENTRY IN THE DELTA-EPNL PROFILE
C                    TABLE USED FOR THE I-TH UNIQUE AIRCRAFT TYPE.
C                    (INTEGER)
C          EPTR(I) - POINTER TO THE ENTRY IN THE EPNL PROFILE TABLE USED
```

```
C                 FOR THE I-TH UNIQUE AIRCRAFT TYPE, (INTEGER)
C          IDENT(I) - ALPHANUMERIC DESCRIPTOR STRING FOR FLIGHT
C                     PATH IDENTIFICATION. (ALPHA)
C
C          SUBROUTINES AND FUNCTION SUBPROGRAMS CALLED
C             CARDIN, APD, ANEF, XNEW, LASTPT
C
C     .......................................................................
      COMMON  XSTART, XEND, DX, NAC, CONTUR, NMAX(4)
      COMMON  NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12), PCALC(12)
      COMMON  DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)
      COMMON  PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), IDENT(13)
      COMMON  DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)
      COMMON  PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)
      DIMENSION  NEFCON(7), IY(7), XCLOSE(7)
      REAL  NEF1, NEF2
      INTEGER ALTNAM
C
      NEFCON(1) = 25
      NEFCON(2) = 30
      NEFCON(3) = 35
      NEFCON(4) = 40
      NEFCON(5) = 45
      NEFCON(6) = 50
      NEFCON(7) = 55
C
      NMAX(1) = 20
      NMAX(2) = 12
      NMAX(3) = 12
      NMAX(4) = 25
      DO 1  I=1,4
      NTET(I) = 0
    1 NFET(I) = 0
      ALTNAM(1) = 1
      NTET(2) = 1
      NFET(2) = 1
C
    2 CALL CARDIN
C
      X = XSTART
      NNEXT = 7
      LINCNT = 0
      DO 3  N=1,7
      XCLOSE(N) = 0.
    3 IY(N) = 4000
C
   11 CALL APD(X)
      NCON = NNEXT
```

```
C
      DO 40   N=1,NCON
      LPCNT = -20
      CONTUR = NEFCON(N)
      Y2 = IY(N)
   13 Y1 = Y2 * 0.707
      CALL ANEF (Y2, NEF2)
      IF (NEF2 + 10.) 15, 15, 16
   15 Y2 = Y2 / 2.0
      IF (Y2 - 50.) 29, 13, 13
   16 CALL ANEF(Y1,NEF1)
   21 YO = XNEW(Y1, NEF1, Y2, NEF2, CONTUR)
      IF (YO - 30000.) 23, 23, 22
   22 YO = 30000.
   23 CONTINUE
      IF (YO - 12.6) 24, 25, 25
C
   24 CONTINUE
      CALL LASTPT(X, XCLOSE(N))
      YO = 0.
      NNEXT = NNEXT - 1
      GO TO 28
C
   25 IF (ABS(YO - Y1) - 2.) 28, 28, 26
   26 IF (ABS((YO - Y1) / YO) - 0.001) 28, 28, 27
   27 Y2 = Y1
      NEF2 = NEF1
      Y1 = YO
      CALL ANEF (Y1, NEF1)
      LPCNT = LPCNT + 1
      IF (LPCNT) 21, 21, 29
   29 IX = X
      WRITE(6,3040) IX, NEFCON(N)
 3040 FORMAT(10X,I8,7X,'* UNDETERMINED ERROR',
     1 ' FOR NEF', I3, ' CALCULATION')
C
   28 IY(N) = YO + 0.5
   40 CONTINUE
C
C
      LINCNT = LINCNT + 1
      IF (LINCNT) 43, 42, 42
   42 LINCNT = -50
      WRITE (6, 3004)   IDENT
      WRITE (6, 3001)   NEFCON
C
   43 IX = X + 0.5
      WRITE (6, 3005) IX, (IY(N), N=1,NCON)
```

```
C
      IF (NNEXT) 55, 55, 53
C
   53 X = X + DX
C
      IF (X - XEND) 11, 11, 55
C
   55 IFLG = 2
      WRITE (6, 3006)
      DO 70  N=1,7
      IX = XCLOSE(N) + 0.5
      IF (IX) 70, 70, 60
   60 GO TO (61, 62, 63, 64, 65, 66, 67), N
   61 WRITE (6, 3031) IX
      GO TO 69
   62 WRITE (6, 3032) IX
      GO TO 69
   63 WRITE (6, 3033) IX
      GO TO 69
   64 WRITE (6, 3034) IX
      GO TO 69
   65 WRITE (6, 3035) IX
      GO TO 69
   66 WRITE (6, 3036) IX
      GO TO 69
   67 WRITE (6, 3037) IX
   69 IFLG = 1
   70 CONTINUE
      GO TO (71, 72), IFLG
   71 WRITE (6, 3030)
C
   72 GO TO 2
C
 3001 FORMAT ('0', 32X, 'DISTANCE TO CONTOUR IN FEET' / 11X, 'POINT ON'/
     1  9X, 'FLIGHT TRACK', 7I8 / 9X, '------------    ------  ------  -
     2-----  ------  ------  ------  ------')
 3004 FORMAT ('1', 15X, 13A4 / 9X, '-------------------------------------
     1-----------------------------------')
 3005 FORMAT (10X, I8, 4X, 7I8)
 3006 FORMAT ('0')
 3030 FORMAT ('+', 7X, 'CONTOUR CLOSING' / 8X, 'POINT ON FLIGHT'
     1  / 8X, 'TRACK')
 3031 FORMAT ('+', 21X, I8)
 3032 FORMAT ('+', 29X, I8)
 3033 FORMAT ('+', 37X, I8)
 3034 FORMAT ('+', 45X, I8)
 3035 FORMAT ('+', 53X, I8)
 3036 FORMAT ('+', 61X, I8)
```

```
 3037 FORMAT ('+', 69X, I8)
C
      END
C
C
C     ..........................................................................
C
C        SUBROUTINE CARDIN
C
C        PURPOSE
C           TO READ DATA NECESSARY TO COMPUTE
C           NEF CONTOURS FOR A FLIGHT PATH
C
C        USAGE
C           CALL CARDIN
C
C        REMARKS
C           THIS ROUTINE CONTROLS THE INPUT OF ALL DATA TO THE PROGRAM.
C           THE ROUTINE READS THE BLOCK OF DATA FOR A SINGLE FLIGHT
C           PATH AND PERFORMS VARIOUS CHECKS ON THE DATA TO TRAP LOGICAL
C           ERRORS WHICH WOULD RESULT IN ERRONEOUS COMPUTATIONS.
C
C        SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED
C           SIN, COS, PDATA, CPCOR
C
C     ..........................................................................
C
C
C
      SUBROUTINE CARDIN
C
      COMMON  XSTART, XEND, DX, NAC, CONTUR, NMAX(4)
      COMMON  NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12), PCALC(12)
      COMMON  DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)
      COMMON  PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), IDENT(13)
      COMMON  DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)
      COMMON  PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)
C
      INTEGER  ERRFLG, ACALC, PCALC, EXPCRC, TRAP, ALTDIR,      POWDIR
      INTEGER  EPNDIR, ALTNAM, POWNAM, PNLNAM, CARD, DSCNAM, DSCRPT
      INTEGER  APTR, PPTR, EPTR
      REAL NFLTS, NITFLT
      DIMENSION  BUFF(8), TEMP(2,8), NFLTS(2,8,20)
C
      NSEG = 8
C
```

```
C     ----- INITIALIZATION
C              1.  CLEAR ERROR FLAG
C              2.  SET LINE CCUNT TO -5
C              3.  CLEAR NUMBER CF CONCENSEC AIRCRAFT
C              4.  CLEAR NUMBER OF FLIGHTS
C              5.  CLEAR LIST CF REQUIRED ALTITUDE PRCFILES
C              6.  CLEAR LIST OF REQUIRED CELTA-EPNL PRCFILES
C
    2 NAC = C
      ERRFLG = 1
      LINCNT = -5
      CC 6  I=1,2
      CC 6  J=1,8
      CC 6  K=1,20
    6 NFLTS(I,J,K) = 0.
      CC 10 I=1,12
      ACALC(I) = 0
   1C PCALC(I) = 0
C
C     ----- REAC CARD WITH FLIGHT PATH ICENTIFICATICN AND PARAMETERS
C
      READ (5, 1C01) IDENT, XSTART, XENC, DX, RWL, GS
C
C     ----- WRITE FLIGHT PATH IDENTIFICATICN
C
      WRITE (6, 3001) IDENT
      WRITE (6, 3000)
C
C     ----- ARE ALL PARAMETERS ZERO
C
      IF (XSTART + XENC + DX + RWL + GS) 15, 15, 2C
C
C     ----- SET ERROR FLAG
C
   15 ERRFLG = 0
      GC TO 5C
C
C
C     ----- WRITE FLIGHT PATH PARAMETERS
C
   2C WRITE (6, 30C2) XSTART, RWL, XENC, GS, CX
      WRITE (6, 3000)
      WRITE (6, 3003)
C
C     ----- STARTING POSITION OF PATH NEGATIVE
C
      IF (XSTART) 22, 23, 23
C
```

```
C     ----- WRITE ERROR AND SET FLAG
C
   22 WRITE (6, 3901)
      ERRFLG = 0
C
C     ----- ENDING POSTION ON PATH NEGATIVE
C
   23 IF (XEND) 24, 25, 25
C
C     ----- WRITE ERROR AND SET FLAG
C
   24 WRITE (6, 3902)
      ERRFLG = 0
C
C     ----- ENDING POSITION GREATER THAN STARTING POSITION
C
   25 IF (XEND - XSTART) 26, 30, 28
C
C     ----- IS INCREMENT ALONG PATH NEGATIVE
C
   26 IF (DX) 30, 27, 27
C
C     ----- WRITE ERROR AND SET ERROR FLAG
C
   27 WRITE (6, 3903)
      ERRFLG = 0
      GO TO 30
C
C     ----- IS INCREMENT ALONG PATH POSITIVE
C
   28 IF (DX) 29, 29, 30
C
C     ----- WRITE ERROR AND SET ERROR FLAG
C
   29 WRITE (6, 3903)
      ERRFLG = 0
C
C     ----- CREATE ALTITUDE PROFILE FOR LANDINGS. SET COORDINATES OF
C           FIRST POINT. SET NUMBER OF PROFILE POINTS TO 1
C
   30 NALT(1) = 1
      ALT (1,1,1) = 0.
      ALT (1,2,1) = 0.
C
C     ----- ARE RUNWAY LENGTH AND GLIDE SLOPE BOTH ZERO
C
      IF (RWL + GS)  32, 50, 32
C
```

```
C     ----- TEST VALUE OF GLIDE SLOPE
C
   32 IF (GS) 33, 50, 35
C
C     ----- WRITE ERROR AND SET ERROR FLAG
C
   33 WRITE (6, 3907)
      ERRFLG = 0
      GO TO 50
C
C     ----- COMPUTE SECOND AND THIRD COORDINATE POINTS ON LANDING PROFILE
C           FROM GLIDE SLOPE AND RUNWAY LENGTH
C
   35 GS = 1.74533E-2 * GS
      TANGS = SIN(GS) / COS(GS)
      ALT (2,1,1) = RWL - 50./TANGS
      ALT (2,2,1) = 0.
      ALT (3,1,1) = RWL + 1.E5
      ALT (3,2,1) = 1.E5 * TANGS + 50.
C
C     ----- IS X VALUE OF SECOND POINT POSITIVE
C
      IF (ALT(2,1,1)) 37, 37, 39
C
C     ----- WRITE ERROR AND SET ERROR FLAG
C
   37 WRITE (6, 3905)
      ERRFLG = 0
      GO TO 50
C
C     ----- SET NUMBER OF PROFILE POINTS TO 3
C
   39 NALT(1) = 3
C
   50 READ (5, 1002) IOP1, IOP2, BUFF
C
  501 IF (IOP1) 100, 100, 51
   51 IF (IOP1 - 99) 200, 200, 52
   52 EXPCRD = 1
      IF (IOP1 - 199) 300, 300, 53
   53 IF (IOP1 - 999) 54, 55, 55
   54 WRITE (6, 3908) IOP1
      GO TO 50
C
   55 STOP
C
C
C
```

```
  300 ICP = ICP1 - 100
      N = IOP2
      IF (N) 305, 305, 306
  305 N = 1
C
  306 DO 310  I=1,N
      CALL PDATA(IOP)
      IF (IOP) 307, 307, 310
  307 ERRFLG = 0
      ICP = ICP1 - 100
  310 CONTINUE
      LINCNT = 0
      GO TO 50
C
C
  200 CARD = IOP2
      IF (CARD - 1) 202, 206, 202
  202 WRITE (6, 3914) ICP1, ICP2
      ERRFLG = 0
      GO TO 50
C
  206 NAME = ICP1
      DO 204  I=1,NSEG
  204 TEMP(1,I) = BUFF(I)
C
      READ (5, 1002) ICP1, IOP2, BUFF
C
      IF (NAME - ICP1) 208, 205, 208
  208 WRITE (6, 3914) ICP1, ICP2
      ERRFLG = 0
      GO TO 501
C
  205 IF (IOP2 - 2) 200, 209, 200
  209 DO 210  I=1,NSEG
  210 TEMP(2,I) = BUFF(I)
C
      LINCNT = LINCNT + 1
C
      IF (LINCNT) 218,216, 216
  216 WRITE (6, 3001) IDENT
      WRITE (6, 3000)
      WRITE (6, 3003)
      LINCNT = -5
C
  218 N = NTET(1)
      DO 220  IENT = 1,N
      IF (NAME - DSCNAM(IENT))  220, 224, 220
  220 CONTINUE
```

```
C
      WRITE (6, 3909) NAME, (J, (TEMP(I,J), I=1,2), J=1,NSEG)
      ERRFLG = 0
      GO TO 50
C
  224 WRITE (6, 3011) NAME, (DSCRPT(I, IENT), I=1,3),
     1  (J, (TEMP(I,J), I=1,2), J=1,NSEG)
C
      TRAP = 1
      DO 238  I=1,NSEG
      NAME = ALTDIR(I, IENT)
      N = NTET(2)
      DO 228  J=1,N
      IF (NAME - ALTNAM(J)) 228, 230, 228
  228 CONTINUE
      WRITE (6, 3910) NAME
      TRAP = 0
  230 NAME = POWDIR(I, IENT)
      N = NTET(3)
      DO 232  J=1,N
      IF (NAME - POWNAM(J)) 232, 234, 232
  232 CONTINUE
      WRITE (6, 3911) NAME
      TRAP = 0
  234 NAME = EPNDIR(I, IENT)
      N = NTET(4)
      DO 236  J=1,N
      IF (NAME - PNLNAM(J)) 236, 238,236
  236 CONTINUE
      WRITE (6, 3912) NAME
      TRAP = 0
  238 CONTINUE
C
      IF (TRAP) 239, 239, 244
  239 ERRFLG = 0
      GO TO 50
C
  244 DO 246  J=1,2
      DO 246  I=1,NSEG
  246 NFLTS(J,I,IENT) = NFLTS(J,I,IENT) + TEMP(J,I)
      GO TO 50
C
C
  500 STOP
C
  100 CONTINUE
  102 IF (ERRFLG) 103, 103, 104
  103 WRITE (6, 3913)
```

```
      GC TO 2
  104 NN = NTET(1)
      CC 150  K=1,NN
      CC 150  J=1,NSEG
      IF (NFLTS(1,J,K) + NFLTS(2,J,K)) 150, 15C, 105
  1C5 IA2 = ALTDIR(J,K)
      IA3 = PCWDIR(J,K)
      IA4 = EPNDIR(J,K)
C
      TCTALD = 0.
      TCTALN = C.
      CC 112  K1=K,NN
      CC 112  J1=1,NSEG
      CAYFLT = NFLTS(1,J1,K1)
      NITFLT = NFLTS(2,J1,K1)
      IF (DAYFLT + NITFLT) 110, 110, 1C6
  106 IF (IA2 - ALTDIR(J1,K1)) 112, 1C7, 112
  107 IF (IA3 - PCWDIR(J1,K1)) 112, 1C8,112
  1C8 IF (IA4 - EPNDIR(J1,K1)) 112, 11C, 112
C
  11C TCTALD = TCTALD + CAYFLT
      TCTALN = TCTALN + NITFLT
      NFLTS(1,J1,K1) = 0.
      NFLTS(2,J1,K1) = 0.
  112 CCNTINUE
      IF (NAC - 50) 118, 118, 115
  115 NAC = 1
      ERRFLG = 0
      WRITE (6, 3915)
  118 CCNTINUE
      NAC = NAC + 1
C
      CPER(NAC) = CPCOR(TCTALC, TCTALN)
C
      N = NTET(2)
      CC 121  NENT=1,N
      IF (IA2 - ALTNAM(NENT))  121, 126, 121
  121 CCNTINUE
      STCP1
  126 CC 125  L=1,N
      IF (ACALC(L)) 123, 123, 122
  122 IF (ACALC(L) - NENT) 125, 124, 125
  125 CCNTINUE
  123 ACALC(L) = NENT
  124 APTR(NAC) = NENT
C
      N = NTET(3)
      CC 131  NENT=1,N
```

```
      IF (IA3 - PCWNAM(NENT)) 131, 132, 131
  131 CONTINUE
      STOP1
  132 DO 130  L=1,N
      IF (PCALC(L)) 128, 128, 127
  127 IF (PCALC(L) - NENT) 130, 129, 130
  130 CONTINUE
  128 PCALC(L) = NENT
  129 PPTR(NAC) = NENT
C
      N = NTET(4)
      DO 135  NENT=1,N
      IF (IA4 - PNLNAM(NENT))  135, 136, 135
  135 CONTINUE
      STOP1
  136 EPTR(NAC) = NENT
C
  150 CONTINUE
      IF (ERRFLG) 155, 155, 152
  152 IF (NAC) 2, 2, 153
  153 RETURN
  155 WRITE (6, 3913)
      GO TO 2
C
C
 3000 FORMAT (9X, '-----------------------------------------------------------
     1-----------------')
 3001 FORMAT ('1', 15X, 13A4)
 3002 FORMAT (18X, 'START AT', F8.0, 15X, 'RUNWAY LENGTH', F8.0 /
     1  19X, 'STOP AT', F8.0, 17X, 'GLIDE SLOPE', F8.1 /
     2  18X, 'INTERVAL', F8.0)
 3003 FORMAT ('0', 12X, 'AIRCRAFT CLASSIFICATION', 18X, 'VOLUME OF OPERA
     1TIONS' /  13X, '-------------------------      TRIP LENGTH    ---------
     2------------' / 14X, 'NAME     DESCRIPTION', 6X, 'CATEGORY',
     3  7X, 'DAYTIME   NIGHTTIME' /  14X, '----    -------------    ----
     4-------   -------   ----------')
 3011 FORMAT ('0', 6X, I10, 6X, 3A4, I10, 6X, 2F11.3 / (35X, I10, 6X,
     1  2F11.3))
C
 3901 FORMAT (19X, '* STARTING POINT CANNOT BE NEGATIVE')
 3902 FORMAT (19X, '* STOPPING POINT CANNOT BE NEGATIVE')
 3903 FORMAT (19X, '* INTERVAL IS OF WRONG SIGN')
 3907 FORMAT (19X, '* GLIDE SLOPE CANNOT BE NEGATIVE')
 3906 FORMAT (19X, '* RUNWAY LENGTH MUST BE GREATER THAN ZERO')
 3905 FORMAT (19X, '* RUNWAY TOO SHORT FOR GLIDE PATH')
 3908 FORMAT ('0', 18X, '* INVALID OPERATION CODE(', I10, ')')
 3909 FORMAT ('0', 6X, I10, 5X, '* UNDEFINED *', I10, 6X, 2F11.3 /
     1  (35X, I10, 6X, 2F11.3))
```

```
3910 FORMAT (19X, '* ALTITUDE PROFILE UNDEFINED (', I10, ')')
3911 FORMAT (19X, '* DELTA-EPNL PROFILE UNDEFINED (', I10, ')')
3913 FORMAT (24X, '*** PROGRAM CANNOT COMPUTE THIS CONTOUR ***')
3912 FORMAT (19X, '* EPNL FUNCTION UNDEFINED (', I10, ')')
3914 FORMAT ('0', 18X, '* CARD MISSING OR OUT OF ORDER,  A/C CLASS',I3,
    1   ', CARD NO', I3)
3915 FORMAT ('0', 18X, '* CONDENSED AIRCRAFT TABLE FULL')
C
1001 FORMAT (12A4, A3, 2F7.0, F5.0, F6.0, F4.0)
1002 FORMAT (2I3, 8F8.0)
     END
C
C    ...................................................................
C
C        SUBROUTINE PDATA
C
C        PURPOSE
C           TO ENTER AIRCRAFT DESCRIPTORS AND PERFORMANCE DATA
C
C        USAGE
C           CALL PDATA (OPCODE)
C
C        DESCRIPTION OF PARAMETERS
C           OPCODE   -   INTEGER VALUE TO DENOTE ACTION TO BE TAKEN
C                         1 = ENTER NEW AIRCRAFT DESCRIPTOR
C                         2 = ENTER NEW ALTITUDE PROFILE
C                         3 = ENTER NEW DELTA-EPNL PROFILE
C                         4 = ENTER NEW EPNL PROFILE
C                        11 = FIX AIRCRAFT DESCRIPTOR TABLE
C                        12 = FIX ALTITUDE TABLE
C                        13 = FIX DELTA-EPNL TABLE
C                        14 = FIX EPNL TABLE
C                        15 = FIX ALL TABLES
C
C    ...................................................................
C
C

     SUBROUTINE PDATA (OPCODE)
C
     COMMON   XSTART, XEND, DX, NAC, CONTUR, NMAX(4)                             COM  1
     COMMON   NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12), PCALC(12)         COM  2
     COMMON   DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)           COM  3
     COMMON   PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), ICENT(13)         COM  4
     COMMON   DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)             COM  5
     COMMON   PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)                      COM  6
     INTEGER   OPCODE, DSCNAM, DSCRPT, ALTNAM, POWNAM, PNLNAM
```

```
      INTEGER  PRP, ALTDIR, PCWDIR, EPNDIR, DTEMP, ATEMP, PTEMP, ETEMP
      DIMENSION  DTEMP(3), ATEMP(8), PTEMP(8), ETEMP(8)
      DIMENSION  ALTTEM(10,2), POWTEM(10,2), EPNTEM(35,2), TEMP(10)
      EQUIVALENCE (ALTTEM(1,1), POWTEM(1,1), EPNTEM(1,1))
C
      NSEG = 8
      IF (OPCODE - 1) 900, 110, 10
   10 IF (OPCODE - 3) 120, 130, 11
   11 IF (OPCODE - 5) 140, 900, 12
C
   12 IF (OPCODE - 11) 900, 210, 13
   13 IF (OPCODE - 13) 220, 230, 14
   14 IF (OPCODE - 15) 240, 250, 15
C
   15 IF (OPCODE - 21) 900, 310, 16
   16 IF (OPCODE - 23) 320, 330, 17
   17 IF (OPCODE - 25) 340, 350, 18
   18 GO TO 900
C
  110 READ (5, 1001) NAME, DTEMP, (ATEMP(I),PTEMP(I),ETEMP(I), I=1,NSEG)
C
      M = NTET(1)
      N = M + 1
C
      IF (N - NMAX(1)) 111, 111, 910
  111 IF (M) 112, 112, 113
  113 DO 112  I = 1,M
      IF (DSCNAM(I) - NAME) 112, 911, 112
  112 CONTINUE
      DSCNAM(N) = NAME
      DO 114  I=1,3
  114 DSCRPT(I,N) = DTEMP(I)
      DO 116  I=1,NSEG
      ALTDIR(I,N) = ATEMP(I)
      POWDIR(I,N) = PTEMP(I)
  116 EPNDIR(I,N) = ETEMP(I)
C
      NTET(1) = N
      RETURN
C
  910 WRITE (6, 3910)
      WRITE (6, 3901) NAME
      GO TO 999
  911 WRITE (6, 3911)
      WRITE (6, 3901) NAME
      GO TO 999
C
C
```

```
  120 NN = 0
      READ (5, 1003) NAME, NP, ((ALTTEM(J,I), I=1,2), J=1,6)
  121 NN = NN + 6
      IF (NP - NN) 123, 123, 122
  122 READ (5, 1004) ((ALTTEM(J,I), I=1,2), J=7,10)
      GO TO 121
  123 IF (NAME - 1) 1231, 129, 1231
 1231 M = NTET(2)
      N = M + 1
      IF (NP) 922, 922, 124
  124 IF (NP - 10) 125, 125, 922
  125 IF (N - NMAX(2)) 126, 126, 923
  126 DO 127  I=1,M
      IF (ALTNAM(I) - NAME) 127, 924, 127
  127 CONTINUE
C
      DO 128  I=1,2
      DO 128  J=1,NP
  128 ALT(J,I,N) = ALTTEM(J,I)
      NALT(N) = NP
      ALTNAM(N) = NAME
      NTET(2) = N
      RETURN
C
  129 WRITE(6,3949)
 3949 FORMAT('0',18X,'* ALTITUDE PROFILE 1 ',
     1 'IGNORED,(CALCULATED BY PROGRAM)')
      RETURN
  922 WRITE (6, 3922)
      WRITE (6, 3901) NAME
      GO TO 999
  923 WRITE (6, 3923)
      WRITE (6, 3901) NAME
      GO TO 999
  924 WRITE (6, 3924)
      WRITE (6, 3901) NAME
      GO TO 999
C
C
  130 NN = 0
      READ (5, 1003) NAME, NP, ((POWTEM(J,I), I=1,2), J=1,6)
  131 NN = NN + 6
      IF (NP - NN) 133, 133, 132
  132 READ (5, 1004) ((POWTEM(J,I), I=1,2), J=7,10)
      GO TO 131
  133 M = NTET(3)
      N = M + 1
      IF (NP) 932, 932, 134
```

```
  134 IF (NP - 10) 135, 135, 932
  135 IF (N - NMAX(3)) 136, 136, 933
  136 IF (M) 137, 137, 139
  139 DO 137  I = 1,M
      IF (POWNAM(I) - NAME) 137, 934, 137
  137 CONTINUE
C
      DO 138  I=1,2
      DO 138  J=1,NP
  138 POWER(J,I,N) = POWTEM(J,I)
      NPOW(N) = NP
      POWNAM(N) = NAME
      NTET(3) = N
      RETURN
  932 WRITE (6, 3932)
      WRITE (6, 3901) NAME
      GO TO 999
  933 WRITE (6, 3933)
      WRITE (6, 3901) NAME
      GO TO 999
  934 WRITE (6, 3934)
      WRITE (6, 3901) NAME
      GO TO 999
C
C
  140 ERRFLG = 1
      DO 155  L=1,8
      READ (5, 1002) NAME, PRP, L1, L2, TEMP
      IF (L - 1) 141, 141, 142
  141 NAME1 = NAME
C
  142 IF (NAME1 - NAME) 942, 143, 942
  942 WRITE (6, 3942)
      ERRFLG = 0
  143 IF (PRP) 943, 943, 144
  144 IF (PRP - 2) 145, 145, 943
  943 WRITE (6, 3943)
      ERRFLG = 0
  145 IF (L1) 945, 945, 146
  146 IF (L2 - 35) 147, 147, 945
  147 IF (L2 - L1 -10) 148, 148, 945
  148 IF (L2 - L1) 945, 945, 150
  945 WRITE (6, 3945)
      ERRFLG = 0
  150 IF (ERRFLG) 155, 155, 151
  151 I1 = 0
      DO 152  I=L1,L2
      I1 = I1 + 1
```

```
  152 EPNTEM(I,PRP) = TEMP(I1)
  155 CONTINUE
      IF (ERRFLG) 949, 949, 156
C
  156 M = NTET(4)
      N = M + 1
      IF (N - NMAX(4)) 157, 157, 947
  157 IF (M) 158, 158, 159
  159 DO 158  I = 1,M
      IF (PNLNAM(I) - NAME1) 158, 948, 158
  158 CONTINUE
C
  160 DO 162  I=1,35
      DO 162  J=1,2
  162 PNLEFF(I,J,N) = EPNTEM(I,J)
      PNLNAM(N) = NAME1
      NTET(4) = N
      RETURN
  947 WRITE (6, 3947)
      WRITE (6, 3901) NAME1
      GO TO 999
  948 WRITE (6, 3948)
      WRITE (6, 3901) NAME1
      GO TO 999
  949 WRITE (6, 3901) NAME1
      GO TO 999
  900 WRITE (6, 3900) CPCCDE
  999 CPCCDE = 0
      RETURN
C
C
  210 NFET(1) = NTET(1)
      RETURN
C
  220 NFET(2) = NTET(2)
      RETURN
C
  230 NFET(3) = NTET(3)
      RETURN
C
  240 NFET(4) = NTET(4)
      RETURN
C
  250 DO 252  I=1,4
  252 NFET(I) = NTET(I)
      RETURN
C
C
```

```
  310 NTET(1) = NFET(1)
      RETURN
C
  320 NTET(2) = NFET(2)
      RETURN
C
  330 NTET(3) = NFET(3)
      RETURN
C
  340 NTET(4) = NFET(4)
      RETURN
C
  350 DO 352  I=1,4
  352 NTET(I) = NFET(I)
      RETURN
C
C
 1001 FORMAT (I2, 1X, 3A4, 1X, 8(3I2,2X))
 1002 FORMAT (2I2, 2I3, 10F7.3)
 1003 FORMAT (2I3, 2X, 12F6.0)
 1004 FORMAT (8X, 12F6.0)
 3900 FORMAT ('0', 18X, '* INVALID OPERATION CODE (', I4, ')')
 3901 FORMAT (21X, 'CANNOT ENTER NAME =', I4)
 3910 FORMAT ('0', 18X, '* AIRCRAFT DESCRIPTOR TABLE FULL')
 3911 FORMAT ('0', 18X, '* DUPLICATE AIRCRAFT DESCRIPTOR NAME')
 3922 FORMAT ('0', 18X, '* INVALID NUMBER OF ALTITUDE POINTS')
 3923 FORMAT ('0', 18X, '* ALTITUDE PROFILE TABLE FULL')
 3924 FORMAT ('0', 18X, '* DUPLICATE ALTITUDE PROFILE NAME')
 3932 FORMAT ('0', 18X, '* INVALID NUMBER OF DELTA-EPNL POINTS')
 3933 FORMAT ('0', 18X, '* DELTA-EPNL PROFILE TABLE FULL')
 3934 FORMAT ('0', 18X, '* DUPLICATE DELTA-EPNL PROFILE NAME')
 3942 FORMAT ('0', 18X, '* PNLEFF PROFILE NAMES DO NOT MATCH')
 3943 FORMAT ('0', 18X, '* INVALID PNLEFF PROPAGATION PATH')
 3945 FORMAT ('0', 18X, '* INVALID PNLEFF RANK LIMITS')
 3947 FORMAT ('0', 18X, '* PNLEFF PROFILE TABLE FULL')
 3948 FORMAT ('0', 18X, '* DUPLICATE PNLEFF PROFILE NAME')
      END
C
C    ..............................................................
C
C         SUBROUTINE LASTPT
C
C         PURPOSE
C            TO COMPUTE THE POINT ON THE FLIGHT TRACK WHERE THE
C            CONTOUR CLOSES
C
C         USAGE
C            CALL LASTPT (X, XCLOSE)
```

```
C
C     DESCRIPTION OF PARAMETERS
C        X   -  THE CALLING VALUE OF THIS PARAMETER IS A POINT
C               ON THE FLIGHT TRACK NEAR WHICH THE CONTOUR CLOSES
C
C        XCLOSE   -  THE RETURNED VALUE OF THIS PARAMETER IS THE POINT
C                    ON THE FLIGHT PATH WHERE THE CONTOUR CLOSES
C                    (IE. THE NEF VALUE AT THIS POINT IS EQUAL TO THE
C                    NEF VALUE OF THE CONTOUR CURRENTLY BEING
C                    COMPUTED)
C
C     SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED
C        ANEF, PARAM, XNEW
C
C     METHOD
C        THE ROUTINE PICKS TWO POINTS ON THE FLIGHT TRACK AND
C        COMPUTES THE NEF VALUES AT THESE POINTS. INTERPOLATION
C        BETWEEN THESE POINTS USING THE VALUE OF THE CURRENT CONTOUR
C        BEING COMPUTED YIELDS THE CONTOUR CLOSING VALUE OF X TO
C        BE RETURNED.
C        ONE OF THE POINTS CHOSEN IS THE CALLING VALUE OF X. IF
C        THE ALTITUDE OF ANY AIRCRAFT IS LESS THAN 12.5 FEET AT
C        THIS POINT THE ROUTINE TERMINATES AND RETURNS WITH X
C        EQUAL TO ZERO.
C        THE SECOND POINT IS VARIABLE AND IS CHOSEN IN THE FOLLOWING
C        MANNER. A POINT ON THE TRACK ONE COMPUTATION INTERVAL
C        (DX) LESS THAN THE CURRENT VALUE OF X IS CHOSEN. IF ANY
C        ALTITUDES ARE LESS THAN 12.5 FEET AT THIS POINT, ANOTHER
C        POINT IS CHOSEN HALF AGAIN THE DISTANCE BETWEEN THESE TWO
C        POINTS.  THE ALTITUDE TEST IS PERFORMED AGAIN AND IF
C        ANY ALTITUDE IS LESS THAN 12.5 FEET THE DISTANCE IS
C        HALVED ONCE AGAIN.  THIS SEQUENCE IS REPEATED UNTIL
C        A USABLE VALUE OF X  IS OBTAINED.  IF, AFTER 10 TRIALS,
C        NO USABLE VALUE OF  X  IS OBTAINED THE ROUTINE TERMINATES
C        AND RETURNS WITH X EQUAL TO ZERO.
C
C     ..................................................................
C

      SUBROUTINE LASTPT (X, XCLOSE)
C
      COMMON  XSTART, XEND, DX, NAC, CONTUR, NMAX(4)                    COM   1
      COMMON  NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12),PCALC(12) COM   2
      COMMON  DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)  COM   3
      COMMON  PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), ICENT(13)COM   4
      COMMON  DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)    COM   5
      COMMON  PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)             COM   6
```

```
C
      INTEGER APTR
      REAL NEF1, NEF2
C
C         ----- CHECK AIRCRAFT ALTITUDES AT CALLING VALUE OF X.  IF ANY
C               ARE LESS THAN 12.5 FEET TERMINATE COMPUTATIONS FOR
C               THIS CONTOUR -----
C
C
      DO 5 I=1,NAC
      J = APTR(I)
      IF (Z(J) - 12.5) 30, 5, 5
    5 CONTINUE
C
C
C         ----- IF ALTITUDES ARE OK COMPUTE NEF AT THIS POINT -----
C
      CALL ANEF (0., NEF2)
C
C         ----- NOW COMPUTE NEF DIRECTLY UNDER PATH AT SOME POINT
C               WITH A LESSER VALUE OF  X  -----
C
      XLESS = X - DX
      XINT  =  DX
C
      DO 10  IT = 1,10
C
C         ----- CALCULATE PERFORMANCE PARAMETERS -----
C
      CALL APD (XLESS)
C
C         ----- CHECK FOR ANY ALTITUDES LESS THAN 12.5 FEET -----
C
      DO 7  I=1,NAC
      J = APTR(I)
      IF (Z(J) - 12.5) 8, 7, 7
    7 CONTINUE
C
C         ----- COMPUTE NEF AT THIS POINT -----
C
      CALL ANEF (0., NEF1)
C
C         ----- INTERPOLATE TO FIND VALUE OF X WHERE CONTOUR CLOSES -----
C
      XCLOSE = XNEW (XLESS, NEF1, X, NEF2, CONTUR)
      IF (ABS(X - XCLOSE) - ABS(DX)) 40, 40, 30
C
C         ----- TRY ANOTHER VALUE OF X -----
```

```
C
    8 XINT = XINT/2.
      XLESS = XLESS + XINT
   1C CCNTINUE
C
C        ----- RCUTINE CANNCT COMPUTE CLCSING VALLE OF X -----
C
   3C XCLCSE = .0.
C
C        ----- RESTORE ALTITUDES AND CELTA-EPNL'S -----
C
   4C CALL APC(X)
      RETURN
C
      END
C
C  ..........................................................................
C
C        SUBRCUTINE ANEF
C
C        PURPCSE
C           TC CCMPUTE THE NEF VALUE AT A POINT  F,  A GIVEN
C           DISTANCE PERPENDICULAR TO THE FLIGHT TRACK.
C
C        USAGE
C           CALL ANEF (Y, NEFVAL)
C
C        DESCRIPTICN OF PARAMETERS
C           Y - PERPENDICULAR DISTANCE FRCM PCINT TC FLIGHT TRACK
C           NEFVAL - NEF VALUE AT POINT P
C
C        REMARKS
C           1.   IT IS ASSUMED THAT
C                  A.   NAC IS GREATER THAN ZERO
C                  B.   ALTITUCES ANC EPNL CORRECTICNS HAVE PREVICUSLY
C                       BEEN TABULATED.
C                  C.   NO ALTITUDE IS ECUAL TO ZERC IF THE CALLING
C                       VALUE CF Y IS EQUAL TO ZERC.
C
C        SUBROUTINES AND FUNCTION SUBPRCGRAMS RECUIRED
C           EPNL, SQRT, ALOG10
C
C  ..........................................................................
C
```

```
      SUBROUTINE ANEF (Y, NEFVAL)
C
      COMMON   XSTART, XEND, DX, NAC, CONTUR, NMAX(4)                     COM  1
      COMMON   NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12), PCALC(12) COM  2
      COMMON   DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)   COM  3
      COMMON   PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), IDENT(13) COM  4
      COMMON   DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)     COM  5
      COMMON   PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)              CCM  6
C
      INTEGER   APTR, PPTR, EPTR, PTR
      REAL      NEFLIN, NEF, NEFVAL
C
      NEFLIN = 0.
C
C       ----- COMPUTE NEF FOR EACH AIRCRAFT AND COLLECT CUMULATIVE SUM
C
      DO 20 I=1,NAC
C
C       ----- PICK UP POINTER TO ALTITUDE FOR THIS AIRCRAFT AND
C             CALCULATE SLANT DISTANCE -----
C
      PTR = APTR(I)
      DIST = SQRT(Y*Y + Z(PTR)*Z(PTR))
C
C        ----- CALCULATE PROPAGATION FACTOR -----
C
C                1.  IF LESS THAN OR EQUAL TO ZERO USE GROUND TO
C                    GROUND PROPAGATION.
C                2.  IF BETWEEN ZERO AND ONE INTERPOLATE BETWEEN
C                    GROUND TO GROUND AND AIR TO GROUND PROPAGATION.
C                3.  IF GREATER THAN OR EQUAL TO ONE USE AIR TO
C                    GROUND PROPAGATION.
C
      PF = (Z(PTR) / DIST - 0.075) / 0.05
      PTR = EPTR(I)
      IF (PF) 5, 5, 3
    3 IF (PF - 1.) 6, 7, 7
C
C        ----- GET EPNL -----
C
    5 P = EPNL(PTR, 1, DIST)
      GO TO 10
    6 P = (1. - PF)*EPNL(PTR,1,DIST) + PF*EPNL(PTR,2,DIST)
      GO TO 10
    7 P = EPNL(PTR,2,DIST)
C
C        ----- PICK UP POINTER TO EPNL CORRECTION FOR THIS AIRCRAFT
C              AND COMPUTE TOTAL EPNL FOR THIS AIRCRAFT. -----
```

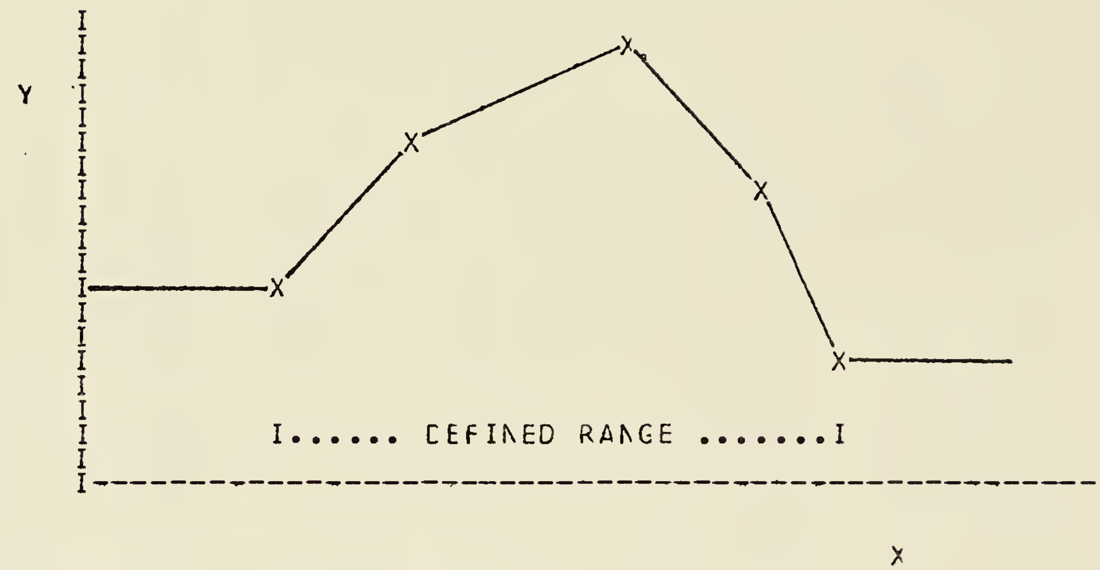
```
C
   10 PTR = PPTR(I)
      P = P + POWSPL(PTR)
C
C        ----- TRUNCATE EPNL IF LESS THAN 80 -----
C
      NEF = 0.
      IF (P - 75.) 19, 19, 13
   13 IF (P - 80.) 14, 14, 15
   14 NEF = (80. + OPER(I)) * (P - 75.) * 0.2
      GO TO 19
C
C        ----- COMPUTE NEF FOR THIS AIRCRAFT -----
C
   15 NEF = P + OPER(I)
   19 NEFLIN = NEFLIN + 10.**(NEF/10.)
   20 CONTINUE
      NEFVAL = 10. * ALOG10(NEFLIN) - 75.
C
      RETURN
C
      END
C
C   ....................................................................
C
C        SUBROUTINE APD
C
C        PURPOSE
C           TO COMPUTE THE NESCESSARY ALTITUDES AND DELTA-EPNLS
C           AT A POINT ALONG THE FLIGHT TRACK.
C
C   ....................................................................
C

      SUBROUTINE APD (X)
      COMMON  XSTART, XEND, DX, NAC, CONTUR, NMAX(4)                     COM   1
      COMMON  NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12), PCALC(12) COM   2
      COMMON  DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)   COM   3
      COMMON  PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), IDENT(13) COM   4
      COMMON  DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)     COM   5
      COMMON  PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)              COM   6
C
      DIMENSION DUMY(2,10)
      INTEGER  ACALC, PCALC
C
C        ----- COMPUTE ALTITUDES -----
C
      M = NTET(2)
```

```
      DO 19 I=1,M
      J = ACALC(I)
      IF (J) 20, 20, 15
   15 N = NALT(J)
      DO 18 K=1,2
      DO 18 L=1,N
   18 DUMY(K,L) = ALT(L,K,J)
   19 Z(J) = CURVE(X,DUMY,N)
C
C         ----- COMPUTE EPNL ADJUSTMENTS -----
C
   20 M = NTET(3)
      DO 29  I = 1,M
      J = PCALC(I)
      IF (J) 30, 30, 25
   25 N = NPOW(J)
      DO 28 K=1,2
      DO 28 L=1,N
   28 DUMY(K,L) = POWER(L,K,J)
   29 POWSPL(J) = CURVE(X,DUMY,N)
C
C
   30 RETURN
C
      END
C
C    ..........................................................................
C
C         FUNCTION EPNL
C
C         PURPOSE
C
C            TO COMPUTE AN EFFECTIVE PERCEIVED NOISE LEVEL AS A
C            FUNCTION OF DISTANCE FROM AIRCRAFT TO OBSERVER.
C
      REAL FUNCTION EPNL(LIST, PRPGTN, DIST)
C
      COMMON   XSTART, XEND, DX, NAC, CONTUR, NMAX(4)                      COM   1
      COMMON   NTET(4), NFET(4), NALT(12), NPOW(12), ACALC(12), PCALC(12)  COM   2
      COMMON   DSCNAM(20), ALTNAM(12), POWNAM(12), PNLNAM(25), APTR(50)    COM   3
      COMMON   PPTR(50), EPTR(50), OPER(50), Z(12), POWSPL(12), IDENT(13)  COM   4
      COMMON   DSCRPT(3,20), ALTDIR(8,20), POWDIR(8,20), EPNDIR(8,20)      COM   5
      COMMON   PNLEFF(35,2,25), ALT(10,2,12), POWER(10,2,12)               COM   6
C
      INTEGER  PRPGTN
      REAL     LOGD, LOGD1
C
C         ----- CONVERT DISTANCE TO LOGARITHMIC SCALE UPON WHICH PNLEFF
```

```
C                TABLES ARE BASED -----
C
      LOGD = 10. * ALOG10(DIST) - 10.
C
C        ----- CHECK FOR INVALID PARAMETERS -----
C
      IF (PRPGTN) 14, 14, 2
    2 IF (PRPGTN - 2) 11, 11, 14
   11 IF (LOGD - 1.) 15, 12, 12
   12 IF (LOGD - 35.) 13, 16, 16
   13 ILOGD = LOGD
      LOGD1 = ILOGD
      C1 = PNLEFF(ILOGD,PRPGTN,LIST)
      C2 = PNLEFF(ILOGD+1,PRPGTN,LIST)
C
C        ----- INTERPOLATE -----
C
      EPNL = C1 + (C2 - C1)*(LOGD - LOGD1)
      RETURN
C
C        ----- PARAMETERS ARE INVALID -----
C
   14 EPNL = 0.
      GO TO 17
   15 EPNL = PNLEFF(1,PRPGTN,LIST)
      GO TO 17
   16 EPNL = PNLEFF(35,PRPGTN,LIST)
   17 WRITE (6, 3001) LIST, PRPGTN, DIST
      RETURN
C
 3001 FORMAT ('0', 20X, 'FUNCTION EPNL  -  INVALID INPUT PARAMETER',
     1       21X, 'LIST =', I3,    'PRPGTN =', I3, ',  DIST =', F9.0)
C
      END
C
C   .....................................................................
C
C        FUNCTION XNEW
C
C        PURPOSE
C           COMPUTE A VALUE OF X ON THE CURVE   Y = M * LOG(X) + B
C           GIVEN THE VALUE OF Y FOR WHICH X IS TO BE COMPUTED AND
C           TWO X,Y COORDINATES ON THE CURVE.
C
      REAL FUNCTION XNEW (X1, Y1, X2, Y2, YNEW)
C        ----- CHECK FOR INVALID PARAMETERS -----
      IF (Y1 - Y2) 2, 10, 2
    2 IF (X1) 20, 20, 3
```

```
    3 IF (X2) 20, 20, 30
   10 XNEW = X2
      RETURN
   20 XNEW = 0.
      RETURN
   30 XNEW = X2 * (X2/X1)**((YNEW-Y2)/(Y2-Y1))
      RETURN
C
      END
C
C     ..................................................................
C
C        FUNCTION OPCOR
C
C        PURPOSE
C           COMPUTE THE NEF CORRECTION FOR A GIVEN NUMBER OF
C           DAYTIME(0700 - 2200) AND NIGHTTIME (2200 - 0700)
C           AIRCRAFT OPERATIONS.
C     ..................................................................
C
      REAL FUNCTION OPCOR(NDAY, NNITE)
      REAL NDAY, NNITE
      A = NDAY/20. + NNITE/1.2
      IF (A) 5, 5, 1
    1 OPCOR = 10. * ALOG10(A)
      RETURN
    5 OPCOR = -100.
      RETURN
      END
C
C     ..................................................................
C
C        REAL FUNCTION CURVE
C
C        PURPOSE
C           COMPUTES A Y VALUE FOR A GIVEN VALUE OF X, WHERE
C           Y = F(X) IS DEFINED BY X,Y POINTS CONNECTED BY STRAIGHT
C           LINE SEGMENTS.       (SEE BELOW)
C
C        USAGE
C           VARIABLE = CURVE(XL, DUMY, NPTS)
C
C        DESCRIPTION OF PARAMETERS
C           XL         - VALUE OF X FOR WHICH Y IS TO BE COMPUTED
C           DUMY(I,J)- TABLE OF X,Y POINTS TO DEFINE FUNCTION
C                        I = 1 FOR X, 2 FOR Y
C           NPTS       - NUMBER OF X,Y POINTS DEFINING FUNCTION
C
```

```
C        REMARKS
C           1.  DUMY ARRAY MUST BE ORDERED SUCH THAT VALUES OF X
C               ARE CONSTANTLY INCREASING
C           2.  IF NPTS IS EQUAL TO OR LESS THAN ZERO, A VALUE
C               OF ZERO WILL BE RETURNED
C           3.  IF THE VALUE OF XL DOES NOT LIE WITHIN THE DEFINED
C               RANGE OF THE FUNCTION, THEN THE VALUE OF Y FOR THE
C               DEFINED VALUE OF X WHICH IS CLOSEST TO XL WILL BE
C               RETURNED.  (IE THE FUNCTION LOOKS LIKE THIS)
C
```




```
C        SUBROUTINES AND FUNCTIONS REQUIRED
C           NONE
C
C     ...................................................................
C
      REAL FUNCTION CURVE (XL, DUMY, NPTS)
      DIMENSION DUMY(2, 10)
      J=1
      IF (NPTS - 1) 6, 5, 1
    1 IF (XL - DUMY(1,J)) 5, 5, 2
    2 DO 3 J=2,NPTS
      IF (XL - DUMY (1,J)) 4, 5, 3
    3 CONTINUE
```

```
      J = NPTS
      GO TO 5
    4 I = J - 1
      CURVE = (DUMY(2,J) - DUMY(2,I))*(XL - DUMY(1,I))/(DUMY(1,J) -
     1DUMY(1,I))+ DUMY(2,I)
      RETURN
    5 CURVE = DUMY(2,J)
      RETURN
    6 CURVE = 0
      RETURN
      END
```

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A computer program, developed by Bolt, Beranek, and Newman, Inc., for the Office of Noise Abatement, Federal Aviation Administration, under Contract No. FA68WA-1900, was adapted to the NPS W. R. Church computer facility and was subsequently utilized to obtain contours of noise exposure for the Monterey Peninsula airport. Two scenarios are presented for the present volume of operations and the resulting NEF contours are shown in Appendix B. The same two plots, with a doubled volume of

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operations, are depicted in Appendix C for a relative comparison. These noise exposure forecasts can be used for noise evaluation and compatible land-use planning in the vicinity of an airport.

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M534 Merickel
c.1 A noise exposure fore-
cast evaluation of the
Monterey Peninsula air-
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